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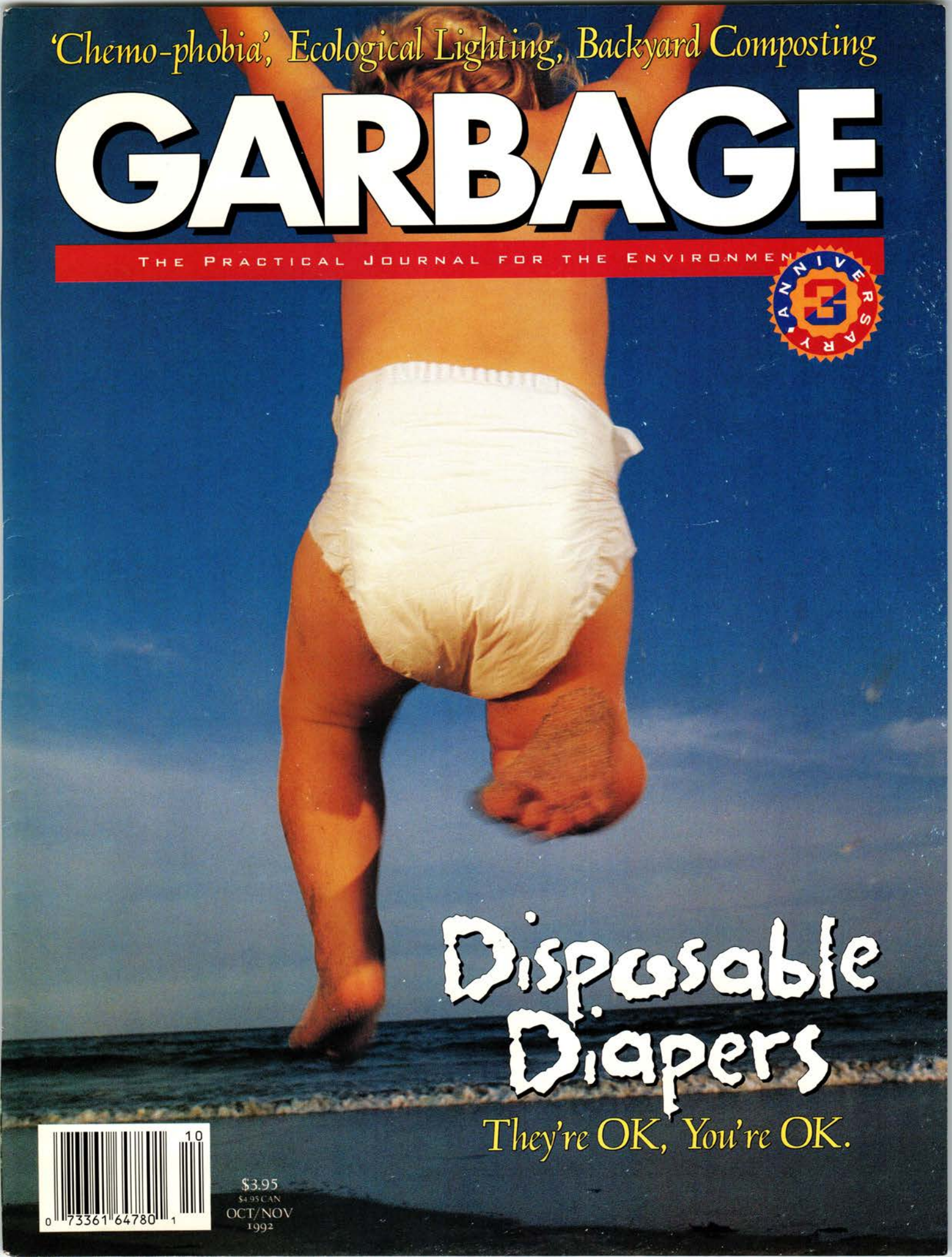
GARBAGE

THE PRACTICAL JOURNAL FOR THE ENVIRONMENT

3 YEAR ANNIVERSARY



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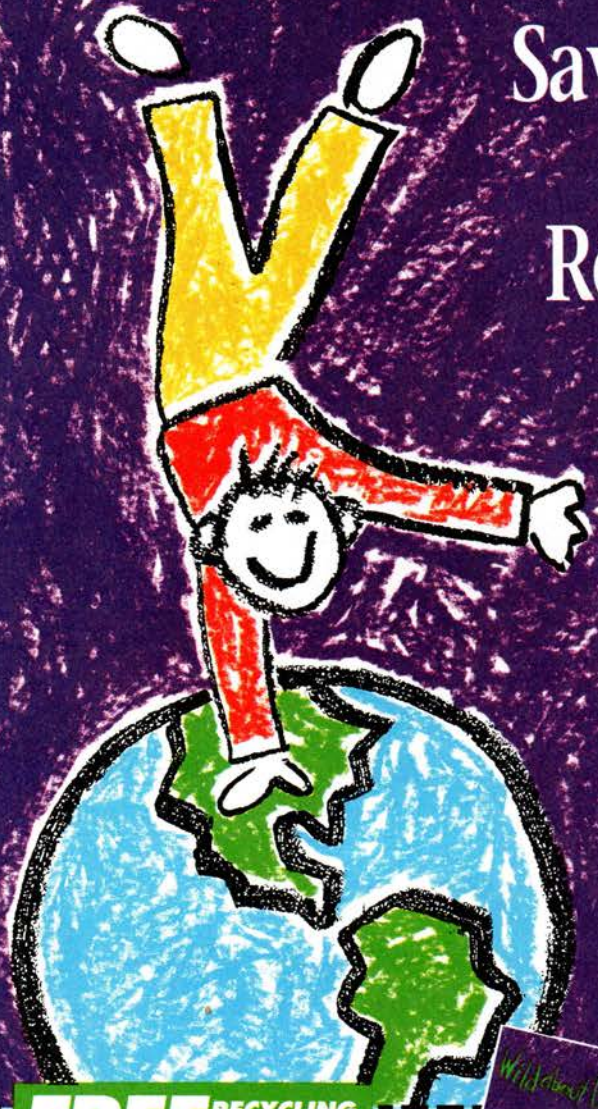

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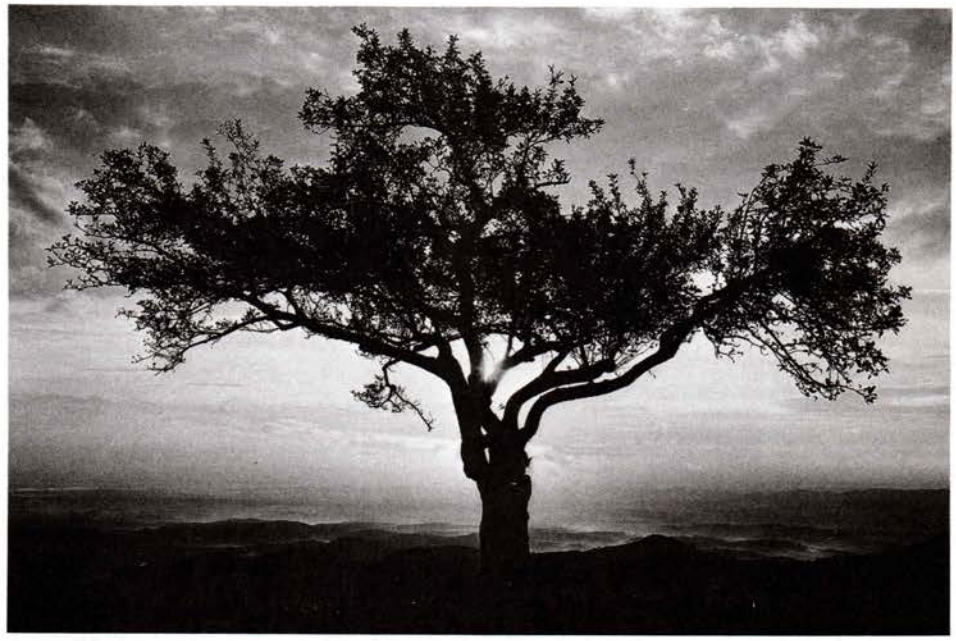

It's a fact. American homes contain dozens of household waste products. A lot of that seemingly harmless stuff we've got lying around the garage, basement and under the kitchen counter is dangerous hazardous waste. It is estimated that the average household contains ten to fifteen gallons of waste materials.

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Volume IV, Number 5

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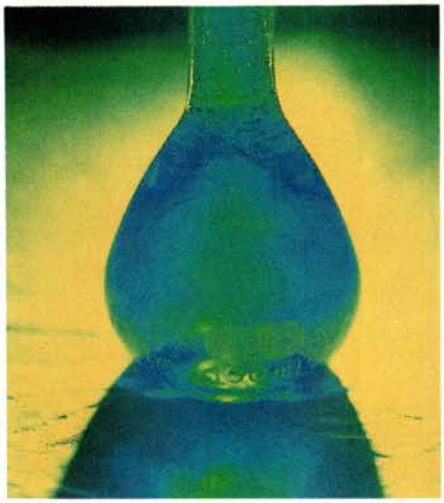

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DEPARTMENTS

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GARBAGE

THE PRACTICAL JOURNAL FOR THE ENVIRONMENT

VOLUME IV, NUMBER 5

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No More Pulling Punches

IT'S TAKEN ME A WHILE TO REALIZE THAT MANY WRITERS ACCEPT the platforms of national environmental organizations as not only infallible but also sacred. That isn't good journalism. In tandem, I've seen in writers a tendency to look for the ulterior motives of industry groups without taking seriously their superior knowledge of product or process. And I have pulled my punches, so to speak, to avoid alienating the well-meaning people who support environmentalist causes.

So, to help clarify our purpose, we've grouped articles into three categories. **The Real World** refers to stories about environmental issues as they inevitably meet money and markets, compromise, and politics. Here you'll find our series on getting rid of garbage, and Art Kleiner's coverage of corporate environmentalism. **Speaking for Science** is new — back to basics in an honest attempt to present the facts and foster an understanding of science without bias or political agenda. **Doing It** is for the majority who believe change starts with the individual. Here, we'll continue to offer practical advice on living with more environmental awareness.

With anniversary fine-tuning, GARBAGE is all the more distinct: industry alongside public-interest groups . . . qualified scientists speaking out, even when the facts don't fit the green agenda . . . hands-on "how-to" articles that don't judge you guilty.

Why the renewed commitment to weed out bias? I have seen our sources, our writers, our editors, even our advertisers be affected by political correctness. The overwhelming pressure to be pro-environment has resulted in media bias, a distrust of business, and scientists who won't talk because they refuse to be quoted out of context. This is a sorry state of affairs that will ultimately hurt environmentalists' credibility.

Strangely, even with GARBAGE's tendency to lean green, our hate mail comes from self-proclaimed environmentalists who call us "right-wing."

Given that it is not rewarding for me to edit a magazine that tries to please everybody, I have decided to pursue more emphatically my original idea: to publish a magazine covering environmental topics, but not necessarily just for environmentalists.

So I've been looking for intelligent writers and experts who congratulate or castigate individuals, organizations, and industry based on fact and not on unfounded assumptions. The brave voices are out there. I've read some of them, occasionally with shock. Now I find these voices are being labeled "an anti-environmental backlash," with hints of conspiracy. I suppose that's to be expected. (I further suppose that, indeed, some people will get famous speaking against environmental policy, just as some got famous speaking against industry.)

I don't buy this us-against-them arguing. I certainly don't buy the conspiracy theories. I think what has brought out the dissenting voices is the same thing that's happened to me. We found some holes. We educated ourselves. Sometimes, we changed our minds.

Will GARBAGE turn into a just-the-facts scientific journal? No way. Scientists have their own problems! In an effort to separate science from emotion, fact from opinion, they must sometimes ignore the human factor. Most of us would agree that there is a qualitative difference between falling and skinning your knee, and being held down while someone sandpapers it. Scientists bent on defending the purity of risk assessment would no doubt go to extremes to insist that the severity of the wound and the size of the scab are the same in either case.

So we will report the science (with informal peer review to uncover quacks), but we will keep a humanistic perspective.

▪ *One last note: magazine delivery has moved ahead by four weeks. This is the Oct/Nov issue; next will be Dec/Jan, etc.*

J. OTTO SIEBOLD

LETTERS

Still Fighting Over Fluoride

AS A PRACTICING DENTIST, I EXPERIENCED the era *before* fluoride [when] patients and dentists were caught in a treadmill of "drilling, filling, and billing" the same teeth over and over until they were capped or extracted ("The Great Fluoride Fight," May/June '92). I see the dramatic difference that fluoridated water has made, typified by a child approaching high school or college having had few or no decayed teeth in his entire life!

I am chagrined to see you give credence to Dr. Yiamouyiannis, a professional fluoridation opponent whose slipshod research and frightening contentions have been shown time and again to be seriously flawed and untrue by reputable researchers. Yet he continues to spout the same erroneous beliefs and "statistics" year after year. The fact that he is the "science director" of the National Health Federation would not impress anyone who knows that this organization is the mouthpiece of a group of vitamin-pill freaks and "holistic medicine" buffs who espouse Laetrile, vitamin/mineral supplements, herbs, and diets to cure *everything*.

I object to the press offering a forum to loudmouth crackpots who win local referenda by shouting their slogans *ad nauseum* until they simply drown out the facts. Repeating a lie doesn't make it the truth.

I also take issue with the continual impugning of the *motives* of dentists by these people. We dentists have dramatically improved the oral health of the average American in the past few decades. For Heaven's sake, people, dentists are trying to *help* you.

C. RICHARD GILMORE, D.D.S.
Highland Park, Ill.

THE NATIONAL HEALTH FOUNDATION, WHICH has been described by the Federal Drug Administration as a front for promoters of unproved remedies and quackery, has opposed smallpox vaccinations and pasteurization of milk, as well as the fluoridation of water. This is the same organization that hired Dr. John A. Yiamouyiannis, whom Steve Coffel quotes as an authority.

ALBERT P. ROSEN, M.D.
Fair Lawn, N.J.

"For Heaven's sake, people, dentists are trying to *help* you." — *a dentist*

"THE GREAT FLUORIDE FIGHT" WAS WELcome, but new information was left out: the lead and arsenic contamination of *all* fluoride products, for example, which the EPA knows about but ignores. Then there's silica, which is in the most widely used fluoridation substance (hydrofluorosilicic acid). Protein binds to silica and can either be excreted, leading to excessive protein loss and kidney failure, or it can form abnormal growths in the intestinal tract, the hallmarks of Crohn's disease.

The clear link to Alzheimer's could have been explored. The connection to gum disease might have been explained. Pediatric textbooks from the 1960s noted that gum disease is rare in healthy children. By the 1980s, updated texts said that 50 percent of American children suffer from that condition. How is fluoride to blame? It can make the teeth too hard, destroying their resiliency. As a result, they can pull away at the roots, forming pockets in which bacteria collects.

There's a well-known dental phenomenon referred to as "Japanese teeth" because of its prevalence in that nation. The teeth are very hard and decay-resistant, but they fall out. The Japanese have diets high in fluoride content (ocean fish, tea, and rice).

FRANCES FRECH
Population Renewal Office
Kansas City, Missouri

Yeas & Nays on Dying

JUST A QUICK NOTE TO CONGRATulate you on what I consider your best effort yet! The July/August issue was devoured by my wife and me in record time! "The Ecological Cost of Dying" was an article I have long awaited! Thanks.

RUSSELL VOIGTLANDER
Shreveport, Louisiana

WAS NANCY BRUNING WRITing about the environmental consequences of the funeral and burial, or was she doing a hatchet job on the funeral and cemetery industry? One moment I admired her thoroughness, and the next I could not believe what I had just read. Being a licensed funeral director for 11 years, I want to set the record straight.

GREG MABLY

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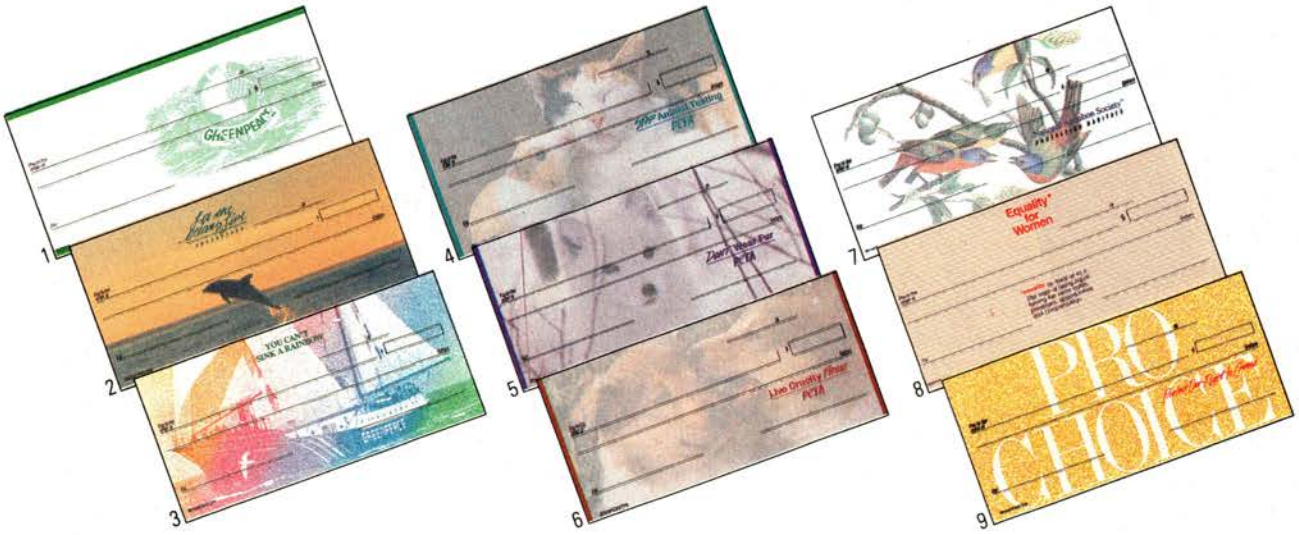

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LETTERS

No fluid which contains infectious or toxic agents is *ever* flushed untreated into the municipal sewer system. One person at home with an infectious disease puts more untreated infectious waste into the sewer system and open trash receptacles in one week than a funeral home does ever. Our business is strongly regulated in its medical waste disposal.

Ms. Bruning discusses how funeral directors claim embalming enables the family to have "a precious, indelible, and perfect 'memory picture' of the dead." Funeral directors are merely quoting psychologists and other health-care professionals. In my own experience, many families have thanked me for their memory of the deceased at peace in the casket, rather than covered in blood, or with tubes protruding from them. I also run grief workshops, where many people have expressed gratitude towards the funeral director for suggesting a viewing.

Ms. Bruning cites a *New York Times* article from 1975 claiming that every acre of our country will be a cemetery in 500 years, if current (1975) trends don't change. She then refutes her outdated quotes by saying trends have indeed changed!

I was surprised to see Ms. Bruning attack the floral industry. "A lot of money, labor, land, water, and horticultural demands are marshalled for sending you out in style." So funeral pieces are not worth the waste? Floral tributes to the dead [go back] to the ancient Greeks.

As far as any revelation regarding reusing gravespace: Once again, I must update her research. Metropolitan cemeteries, like those in New York, for example, have been reusing graves for several decades. I agree that this approach makes sense, but let's give credit where credit is due.

I do applaud her efforts on behalf of organ and tissue donation. It is unfortunate that only one paragraph was dedicated to this potentially positive area of death and "recycling."

Memorial societies and funeral societies have their places in our complex society. I honestly have no axe to grind with any one of them in particular, but let's compare apples to apples. Those who opt for the "society"-type disposition do not get the personalized attention one would get (and pay for) in dealing with a funeral home. A few people in my grief groups regret having gone to a society, because they were not handled with the care and compassion that they felt they were entitled to. But, unlike Ms. Bruning, I will not go on record lumping all societies together. Indeed there have been a few people in my groups who have gone the society route and were extremely satisfied.

It is sad to think responsible, intelligent people like Ms. Bruning still feel that we "exploit sentiment to maximize profits." Ms. Bruning overlooked the compassionate side of our profession. I dare say that almost every funeral home has donated the entire funeral service when a family needed a break due to finances. Those stories, however, don't hold one's attention like a good "exposé." Stories like hers were written for "enquiring minds"... perhaps she should focus her talents there.

DAVID B. FEENEY
John J. Feeney & Sons Funeral Home
Ridgewood, New Jersey

NANCY BRUNING'S ARTICLE "THE ECOLOGical Cost of Dying" is interesting, informative, and timely. Nature has a vast, unpaid workforce ready to recycle all once-living materials. But not [at] six feet deep! At that depth, things slowly putrify in anaerobic conditions. Rather, bodies should be buried in relatively shallow graves or mounds, suitably protected — in the living topsoil — where nature's soil organisms can do their job of quickly and fastidiously cleaning away the soft tissues. Then, in a year or so, if desired, the bones can be disinterred and placed in a compact crypt or vault.

JUSTIN H. BRANDE
Middlebury, Vermont

DURING THE PERIOD OF 1880 TO 1910, *arsenic* was the main component of most embalming fluids. Numerous arsenic-embalmed bodies are contained in older cemeteries. Arsenic, unlike formaldehyde, is a basic element; it will always remain in the environment. It will be susceptible to leaching through the soils of cemeteries into groundwater resources. The potential problems of arsenic-embalmed remains were recently reviewed in *American Cemetery* journal. Co-authored by Melissa Johnson Williams and myself, that article explores the history of arsenic use, potential environmental problems, and plans to evaluate the extent of the problem. Those interested may write to me at:

Iowa Waste Reduction Center
75 Biology Research Complex
University of Northern Iowa
Cedar Falls, IA 50614-0185

JOHN L. KONEFES
Cedar Falls, Iowa

"Air Conditioning" — Hot Air

CORRECTION: *Our mistaken assertion that the boiling point of a liquid drops with increased pressure landed us in hot water ("Why We Need Air Conditioning" July/August '92). In fact: Pressurizing a liquid* raises *its boiling point; water boils at a lower temperature in the mountains. AC coolants heat as they're compressed (outside the house) and cool as they're decompressed (inside the house).*

EVEN THE MILDEST ENVIRONMENTALIST CAN recognize that air conditioning is used much too often. That it helped cause the development boom in the South is exactly the problem: It makes possible environmentally inappropriate choices in factory locations, housing design, even in transit choices.

PAUL BONNEAU
Gaston, Oregon

I HAVE ENJOYED YOUR UNIQUE ANGLE ON environmental issues. I was amazed, enraged, and disgusted, however, to read

LETTERS

"Why We Need Air Conditioning."

I have spent my entire life in the American South and have never used air conditioning. I am involved in a struggle in Virginia to prevent the construction of a high-voltage power line [which], if it is constructed, will cause the deforestation of over 1,000 acres of woodland, expose hundreds of people to high levels of electromagnetic radiation, and carry the electrical equivalent of literally millions of tons of coal and carbon emissions. All to cover summer peak load. Even a fractional reduction in America's AC use would greatly curtail such elaborate suicide. Our children will pay.

You should be clearer about whose side you're on.

ALEXIS ZEIGLER
Louisa, Virginia

GATHERING NAMES FOR DIRECT-MAIL LIST brokers is not the sole reason manufacturers ask you to return their warranty cards ("Junk Mail Redux," May/June '92). When you buy one of our products and return the warranty card, here's what happens: 1) Your name, address, place and date of purchase go into our computer. If you call us later with a warranty claim, we can help you immediately, even if both you and the dealer lose the receipt. 2) We study the demographic information which you, at your discretion, wish to disclose. When trends begin to emerge, we walk over to engineering and say, "Hey, maybe they could use a whizbang that does whatcha-will." That's how innovations are born, part of healthy R&D in a competitive marketplace. 3) We track your name in our system to see if you've contacted us before. If so, where was it that you heard of us? GARBAGE? Well, if we were advertising in GARBAGE, and if you and a lot of other customers also got our number from GARBAGE, then we'd keep advertising in GARBAGE.

Our company does not sell its customers' names to anyone. Personally, I get a little sheepish just asking one for a daytime telephone number. So, while we can't speak for the rest of corporate America, when it comes to warranty cards, we would like to have yours.

TIMOTHY S. GILBERT
Ad. Mgr., Tornado Products, Inc.
Germantown, Wisconsin

CORRECTION: *The photographer's credit was omitted from "Sleuthing Ancient Forests" (Restoration, July/August '92). Paul Rezendes, based in South Royalston, Mass., took the photographs.*

LIFTING THE LID

PEOPLE, NEWS & UPDATES

IN THE FIELD

She Scales Trees to Study the Forest

ASKED TO NAME A MEMORable moment in her career, biologist Meg Lowman tells the story of how she and a student were eating lunch out in the field and observed several woodpeckers feeding.

"They were just stuffing their faces with gypsy moths and they had the remains all hanging out of their mouths," she recalls. "I had never realized what a messy eater a woodpecker was."

Arguably, a moment only a biologist could cherish.

And it was a spectacle few besides Dr. Lowman could have seen up close, for she was dining with the woodpeckers 70 feet above the forest floor.

In their rush to study tropical rain forests, many scientists have been neglecting their own backyards, says Dr. Lowman. So, in the summer of 1991, armed with a $2,000 grant and a competent tree surgeon, she helped build the first permanent "forest-canopy walkway" in the United States.

The wood and cable contraption nestles about thirty feet below the treetops of Williams College's Hopkins Memorial Forest, a 2,400-acre parcel in the northwest corner of Massachusetts. Viewed from ground level in early spring, the canopy appears lifeless in these woods of maple, birch, beech, and oak. But high among the meandering platforms, signs of life abound. Woodpeckers hunt for insects, scampering mammals leave broken branches in their wakes, and the tight, fiery buds of red maple color the leafless skyline.

"One of the first things we observed from the walkway was the condition of leaves in the upper canopy," she says. "The leaves in the upper canopy were very blotchy with yellow blemishes."

Biologist Meg Lowman (foreground) aboard her forest canopy walkway.

At first, she thought the blighted leaves might have been the victims of fungi, but then ruled this theory out — fungus usually affects leaves in a canopy's lower regions, where there's more shade. "At the tops of the trees, where a lot of photosynthesis takes place, is where you'd expect to find the healthiest leaves," she explains.

Her treetop observations could result in vital information for atmospheric scientists studying the dynamics of acid rain, according to David Dethier, director of research for the Hopkins Forest.

Dr. Lowman's work has already yielded some of the first information we have on life in *temperate*-zone forest canopies. The flying squirrel is an example. She and her students discovered a vast, unexpected population of the mammals in Hopkins Forest. The news [*cont. on p. 14*]

JOHN SOARES

is important for those trying to control forest-destroying gypsy moths, because Dr. Lowman has found that flying squirrels eat the insects. There's been a tendency to discount the effects of small mammals above ground level. She has surprised biologists by discovering all kinds of mammals in the canopy, including mice, voles, and porcupines.

Meg Lowman's canopy research dates back to her doctoral work in treetop walkways of the Australian tropics. It has since taken her to South America and Africa.

Her visiting professorship at Williams ended this past summer; she is currently director of research at Florida's Selby Botanical Gardens. Dr. Lowman hopes to return to Massachusetts next summer to work with students on the walkway, which she hopes will serve as a prototype for others. Already, Hampshire College in Amherst, Mass., and the University of Minnesota are building walkways of their own. — *Tom Verde*

BASED IN BOSTON, TOM VERDE REPORTS ON SCIENCE AND THE ENVIRONMENT FOR NATIONAL PUBLIC RADIO.

"It's easy for me to recycle: I pay the caretaker to take it to the dump."

— Pop singer Billy Joel, on why he feels uncomfortable being named a "Champion of the Environment" by a Long Island (NY) environmental group. (*New York Times*, June 23)

TECHNOLOGY

Inventor Plumbs Microwave Toilet

AFTER NINE YEARS OF TINKERING, MASTER plumber Burt Axelrod has pieced together a machine that (get this): microwaves toilet solids. He calls his invention the "Shit Zapper."

The Zapper, about the size of a two-drawer file cabinet, is a radical departure from conventional septic-waste treatment, to say the least. Your typical system collects everything that goes down the drain, and after an extended period of biological action the heavier stuff settles and liquid effluent disperses through a leach field, a system of (intentionally) leaky pipes buried in the ground. Ever since the outhouse moved indoors, most innovations in onsite sewage disposal have focused on treating this liquid effluent. The Zapper, however, works on *solids*, intercepting and burning them before biological breakdown begins.

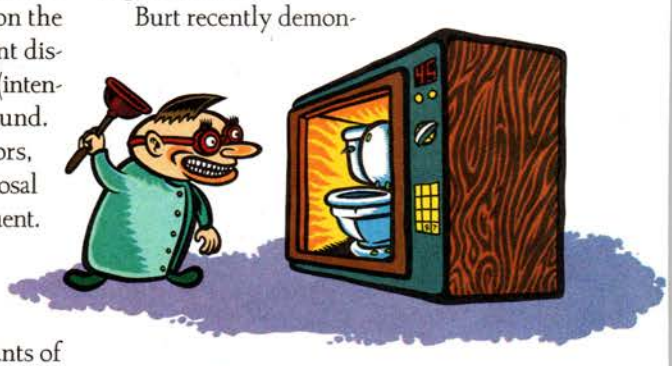
For the past two years, the inhabitants of two selected apartments in a quiet block of Queens, New York City, have unwittingly contributed their fecal matter to the cause of septic engineering. Burt's laboratory in the building's basement diverts the effluent into a prototype Zapper. (Other units are operating in Colorado and New Hampshire.)

The Zapper, its lid removed for demonstration purposes, rests on a table in the basement's center. Burt gestures towards the unit's cavity and explains, "All that solid stuff — the fecal matter, the paper, the hair — falls onto this filter face." (This observer is relieved to note that the unit isn't in use.)

As stuff piles up in the honeycombed, ceramic filter, the Zapper goes into action. Conventional heating coils and magnetrons (you've got them in your microwave oven) rapidly dry and combust the solids. After 45 minutes, a pound of mushy sewage has been reduced to a smudge of clean, powdery ash. Burt claims that liquids from the Zapper can be treated with chlorine, sand and charcoal filters, or even routed to artificial wetlands for biological cleansing. The leach field won't get clogged by overflowing solids (a common cause of failure among septic systems), and the filtered water can be reused for irrigating gardens, car washing, or reflushing.

At most, a family of four might cycle the Zapper three times a day. That would require about four kilowatt hours of power. Buying and installing the Zapper — when and if it becomes commercially available — should cost about the same as one of the more expensive septic systems.

Burt recently demonstrated his "blind test" unit for officers of Hayden-Wegman, Inc., a civil engineering firm long familiar with solid-waste management. Samuel Schwartz, the firm's vice president (and director of the Infrastructure Institute at Cooper Union in NYC) has a "gut feeling" that the Zapper will work commercially. But he quickly adds that "it still requires all the engineering studies: an investigation of emissions, maintenance, and energy consumption; the life of the system and its environmental impact."



While he hasn't yet applied for regulatory approval, Burt feels that licensing officials "are kind of leery of new technology, even though they know they need it." On the other hand, "People are welcoming us, with a kind of 'show us what you've got' attitude."

Maybe that's the most Burt can expect from regulators. After all, they being asked to consider a machine that would zap conventional wisdom on how onsite waste disposal systems are supposed to work.

— *Liora Alschuler*

LIORA ALSCHULER IS A NEW YORK-BASED TECHNICAL COMMUNICATION CONSULTANT AND WRITER.

ROY TOMPKINS

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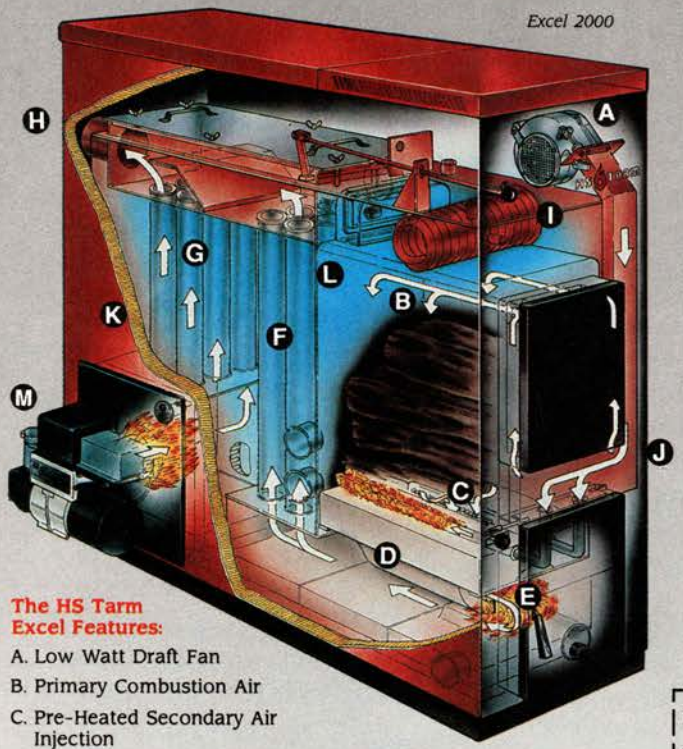

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How to Clean Greener

SPECIAL CIRCUMSTANCES — AN OLD SEPTIC tank or your use of "greywater" to grow flowers — may convince you to switch from supermarket brands to "green" cleaners. But "even natural ingredients are chemicals and must be handled responsibly," says Procter & Gamble's Kris Burbank. Being greener may be more a function of attitude and habits, not what you buy. Try these common-sense suggestions to lower your own contribution to pollution.

- Use the right product for the job, and use it according to instructions on the label. Use it up and dispose of the container in your garbage pickup.
- Clean on a regular basis. Don't wait until the dirt builds up and the job demands more of a cleaning product.
- Choose dirt-resistant surfaces for your home. A floor that can be damp-mopped without detergents, or counters that resist stains, will keep cleaner over the long run — and require less chemical warfare.
- Put a doormat at entrances to minimize dirt tracked into the house. Or have "no shoes" areas inside the house.
- Ask yourself if you are over cleaning. Your office clothes may not need a heavy-duty detergent. A disinfectant may be unnecessary at home.
- Consider "spot power." If you're bleaching your whole laundry load because your children have dirty pant knees, spot clean the knees first by soaking them in soapy water, then wash the load without bleach.
- If you must have a clean smell, try soaking your clothes in a pan of water and lemons. Or treat yourself to some flowers!

— *Deborah DePeyster*

BIOREMEDIATION

A Poison-Eating Fungus

IT'S LIKE THEY ALWAYS SAY: ONE ORganism's toxic waste is another's soup du jour. Scientists say white-rot fungi — wood degraders often found in fallen trees — may be an effective means of cleaning up certain kinds of toxic waste.

Biologists already knew that white-rot breaks down lignin, the complex molecule that binds wood together. At EPA's Office of Research and Development, researchers figured it could take on even more complex organic compounds. At a wood-treatment plant in Brookhaven, Mississippi, researchers formed 11 plots of soil taken from a waste-sludge pile and applied spores from three species of white-rot fungi collected from the undersides of old wooden bridges. Through a series of biochemical reactions, concentrations of the toxicant pentachlorophenol (PCP) were reduced 85 to 90 percent, leaving behind much more benign byproducts.

Potential applications abound. PCP is often used as a wood preservative, and there are over 55 wood-treatment plants nationwide on the EPA's Superfund list. In the days before strict environmental regulations, the plants merely dumped waste preservative into unlined lagoons and leaky storage tanks. These sites are already being cleaned up with bacteria that secrete chemical-eating enzymes. Bacterial methods are effective up to a point — the promise of white-rot, however, is that it can apparently break down tough compounds the bacteria can't.

"There's research left to do, but it could be a crucial clean-up technology," says Steven Safferman, an environmental engineer at the EPA's Risk Reduction Engineering Laboratory in Cincinnati. "It has potential application at a lot of sites."

— *Ethan Seidman*

"A wetlands trip with six nature photographers — definitely a 'Wayne's World' NOT. Most of the things they're auctioning I'd pay *not* to do."

— **Ingrid Sischy**, editor of *Interview*, on the low incentive to bid at a society auction to benefit the environment. (*New York Times*, June 23)

ROY TOMPKINS

The Garbage Index

Portion of households participating in curbside recycling in a NYC neighborhood with a median income of $41,305: **62.7%**

Portion participating in a NYC neighborhood with a median income of $10,872: **6.4%**

Number of materials recovery facilities (MRFs) planned or operating in the U.S., 1990: **104**

Number of MRFs planned or operating, 1992: **222**

Number of landfills opened in U.S., 1986-1991: **364**

Landfills expanded: **407**

Landfills closed: **2,216**

Number of languages in which recycling information is available by telephone to Los Angeles residents: **131**

Sources: *Center for the Biology of Natural Systems, Governmental Advisory Associates,* Resource Recycling, *National Solid Wastes Management Association, Los Angeles Bureau of Sanitation*

Portion of Mass. residents who say utilities should spend money first on building new power plants: **6%**

Portion who say utilities should spend money first on conserving electricity: **93%**

Typical reduced electricity use for lighting in offices participating in the EPA's Green Lights program: **52%**

New utility power-plant investments avoided due to savings garnered by the Green Lights program: **$37.8 million**

Sources: *New England Power Pool, EPA*

Pages of press releases, memos, and schedules printed by the U.N. in Rio each day of the (12-day) Earth Summit: **520,000**

Number of garbagemen working at the Summit convention building: **220**

Amount of garbage hauled away from the convention building each day of the conference: **7 tons**

Estimated population growth worldwide during the Earth Summit: **2,489,760 people**

Sources: Recycling Manager, *International Development Research Centre (Ottawa, Canada)*

Municipal Composting *(July/Aug '90)* Composting mixed garbage into fertilizer did seem a little too good to be true. So while the recent collapse of two major municipal composting programs is too bad, it's not very surprising.

Municipal solid-waste composting operates roughly thus: Garbage trucks unload regular old garbage. With magnets and human hands, some recyclables may be removed, along with large items like carpet or furniture. The remaining garbage is shoved into a giant grinder. The shredded waste is nursed with air and water to encourage microorganisms to digest garbage, turning it into compost.


COMPOSTING
From Backyards to Big-Time

At the nation's largest composting plant, the Agripost facility in Dade County, Fla., the system didn't deliver enough water to the mix. Thus the compost dehydrated instead of reaching a stable, odorless state, says Clark Gregory, a compost guru with Woods End Research Lab. Agripost managers blamed the hot summers when winds dropped and the humid air trapped odors. Neighbors complained, and the county board of commissioners permanently revoked the firm's permit.

At the Riedel plant in Portland, Ore., the system evidently didn't allow for enough oxygen to mingle with the microbes, so that garbage rotted instead of composting. Riedel closed in early '92.

Has large-scale composting kicked the bucket? Not at all, says Dr. Gregory, who points to strict European standards forbidding farmers from using contaminated compost. Such "clean composting" is a concept on the ascent. It calls for separate collection of "wet wastes," which can be composted, from "dry wastes" like cans, bottles, diapers, and other non-compostables.

Landfills Are #1 *(Sept/Oct '90)* The bad news: Landfill capacity in the U.S. continues to decline, putting the squeeze on communities that rely on landfills for getting rid of their discards. The good news: The decline is not occurring as quickly as many had predicted, and some states have even increased their capacity, according to a new report published by the National Solid Wastes Management Association. (Equally unpopular incineration is the other option for dealing with waste left after recycling; even then, leftover ash must be buried.)

The report shows that no one really knows exactly how many solid-waste (MSW) landfills dot the land: Six different organizations, including the EPA, the GAO, NSWMA, and *BioCycle* (magazine) have done surveys, and each have come up with different numbers. "The reported number of MSW landfills in the U.S. in 1990-91 ranged from 4,462 to 10,467," the report says. "The actual number of MSW landfills in the U.S. may never be known until states actively collect and maintain databases."


LANDFILLS ARE #1

ROY TOMPKINS

GARBAGE BAG

OUR READERS SPEAK

Bustin' Fleas

IN RESPONSE TO SHELLEY NATHAN-MAY'S question about fleas in the May/June "Ask Garbage," you described an elaborate routine to solve the problem. I live in California (warm), near the beach (humid), in a house with wall-to-wall carpeting and an indoor/outdoor cat. Of course we had a flea problem. We also have small children, so we wanted to be very careful about what we put on the carpet.

Our vet recommended a service called "FleaBusters." I called and was told that they would put inorganic salts down to dehydrate the fleas and larvae. I wanted to know exactly the kind of salts, and was told "sodium polyborate" — borax. It works: we haven't had fleas for two years now and the kids seem healthy enough.

VICTORIA TAYLOR
Long Beach, Calif.

Contact FleaBusters at 10801 National Blvd., Suite 401, Los Angeles, CA 90064; (310) 470-3532.

Enviro Czech

I AM A PEACE CORPS VOLUNTEER IN THE Trnava region of Czechoslovakia. Up-to-date environmental information is difficult to obtain. Please ask your readers to send us back issues of GARBAGE. I was surprised at first at how eagerly these materials are greeted by the Slovaks, and how creatively they are used. Even sending one or two issues would be a great help.

Mail can be sent, surface, to me at Okresny Urad Zivotneho Prostredia, Kollarova 8, 917 77 Trnava, Czechoslovakia.

ANN M. HOKANSON

The Scoop on Poop

I READ WITH INTEREST THE "ASK GARBAGE" about how to dispose of dog poop (Jan/Feb '92). Living here in the mecca of the dog mushing world, I would like to share these observations:

Many dog foods are full of undigestible filler which passes right through the animal. What goes in must come out, either as calories or waste. When I switched from paying $12 for a 40 lb. bag of cheap nuggets to $28 for highly digestible food, input dropped from six cups a day to two, and waste output fell proportionally. The label on the food we now feed our dogs reads like the menu of a fine restaurant: chicken, fish, liver, eggs, milk — and no mysterious "byproducts."

Dogs burning up to 10,000 calories a day can't run on cornmeal.

JOHN MCRITCHIE
Fairbanks, Alaska

AS A FLIGHT ATTENDANT FOR USAIR, I know for a fact that airlines absolutely do not flush bathroom waste into the air (see "Garbage Bag" March/April '92). The ice formation the reader spoke of was from an airline bathroom, but was caused by a leak in the lav system. When the airplane reached altitude — where the air is below freezing temperature — the leak iced up and fell off the belly of the plane. This was a rare and unfortunate accident.

JILL MALCOLM
Mount Airy, Maryland

No Free Lunch?

YOU PRINTED JOSE VALDEZ'S SUGGESTION that electric cars charge their own batteries by using the "spinning rear wheels" ("Garbage Bag" May/June '92) without noting that such a system would be a perpetual motion machine, violating the first law of thermodynamics: You can't get something for nothing. If the non-driving wheels were hooked up to a generator-battery system while the car is driving, they would create extra friction that would drag on the car, requiring more energy to drive it. You would come out behind, not ahead.

A regenerative *braking* system, however, could be a practical option. During braking a generator would deliver power (which is normally lost as heat in brake linings) to partially recharge the battery.

There's no such things as a free lunch.

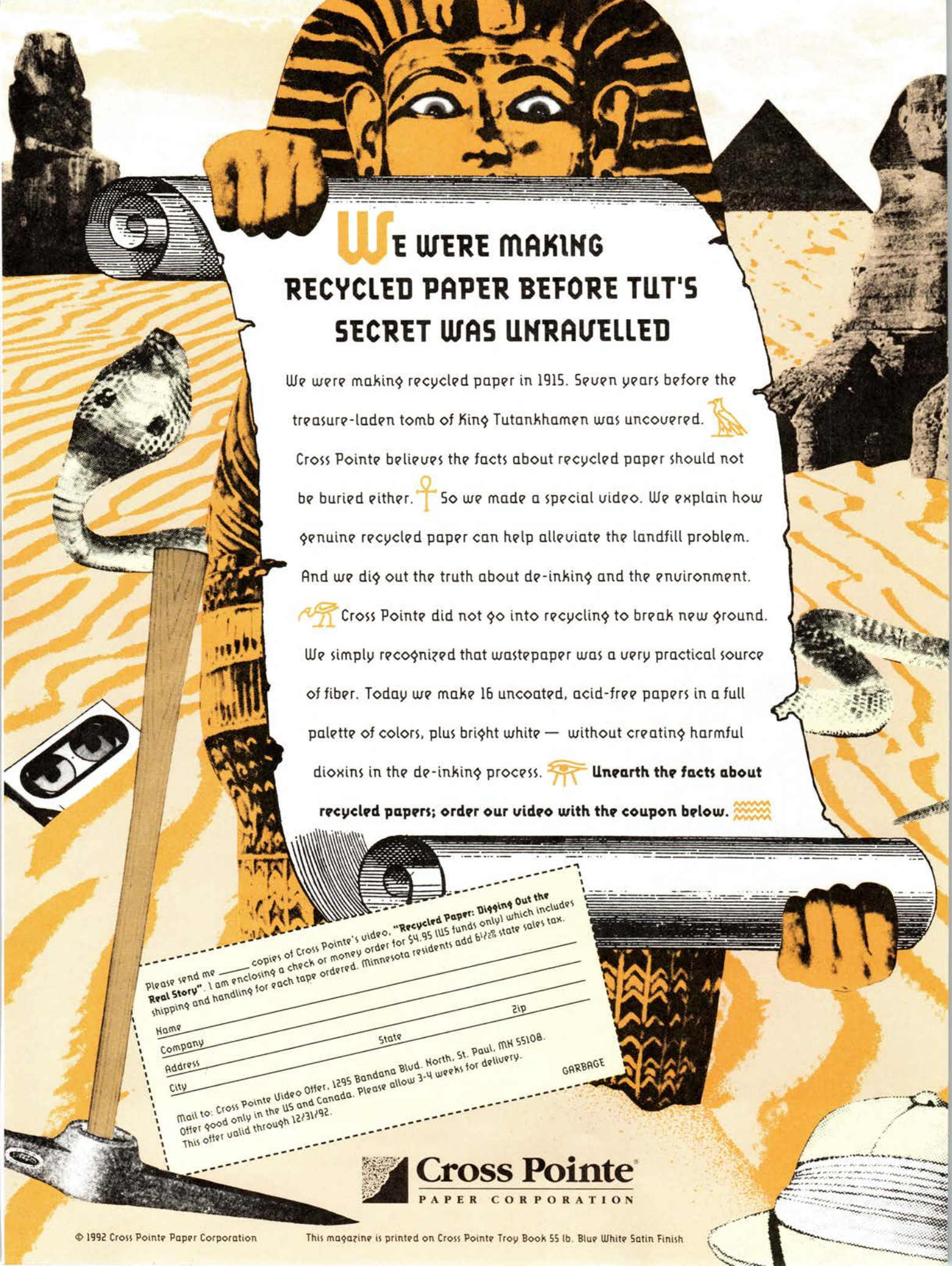
JENNIFER GITLITZ
Berkeley, Calif.

. . . . .

We received several letters requesting more information on what exactly the Burger family, profiled in "Lifting the Lid" (March/April '92), does to reduce waste and recycle. Contact Chris and Cindy Burger at RD 2, Box 365A, Walter Road, Whitney Point, NY 13862.

■ *Got a "how-to" tip, some useful info, or a bit of news? Send it in! Send correspondence to: Ethan the Bag Man, GARBAGE, 2 Main Street, Gloucester, MA 01930. Sorry! We will not be able to print every submission or respond individually.*

ROY TOMPKINS



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GARBAGE

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Hawaii Survive-O

IT'S A CLASSIC BATTLE: OFF-ROAD VEHICLES ON ONE SIDE, WILDLIFE managers on the other. In this case, they're separated — most of the time — by a row of boulders.

Kaena Point, a 30-acre wedge of sand and stone at the western tip of the Hawaiian island Oahu, has always held an allure. The surf is spectacular. The wind hums in the rocks. Flowering vines and shrubs embroider the dunes. This wild beauty brought a tourist train through in 1899, and as transportation evolved, the steel rails gave way to the four-wheel-drive truck, the dirt bike, and the three-wheeler. For decades, these roaring machines ruled the dunes, flattening flora, frightening fauna, and carving the point into a dusty ORV heaven.

Then the duel began. In 1986 this spit of sand was declared a state Natural Area Reserve. In September 1988, a blockade of boulders with a steel gate was installed at the north entrance. Die-hard four-wheelers crept into the western entrance on a plank they laid across the washed-out, cliff-side road, but erosion soon closed that entrance, too. The ORVers grew restless. They cut the hinges off the gate and drove in. Dave Smith, the state biologist who oversees Kaena Point, welded on bigger hinges. ORVers sawed into the lock. Mr. Smith welded on a tougher lock. They sledge-hammered it to death. He rewelded it. They sliced it up with a bandsaw. He dumped a load of boulders in front of the abused gate, and things started to settle down.

Greenery reclaims the tire tracks on Kaena Point.

In the new silence, life began to reassert itself in the reserve. The shrubby, white-flowered naupaka dug into the ORV tracks, as did rare 'ohai, a pretty, silver-green vine with salmon-colored, pea-like flowers, and pa'u-o-Hi'iaka, a blue-flowered vine. Volunteers steadily pull away at non-native weeds which compete for sun and scarce water.

Offshore, an endangered monk seal has claimed the newly peaceful, rocky shoreline as her hangout; threatened green sea turtles and humpback whales also haunt the area. On the closed road, hikers, cyclists, and fishermen explore without fear of careening vehicles.

Return of the "goony bird:" Laysan albatross.

But bringing back the shore birds — albatross, shearwaters, and boobies among them — isn't quite as simple as removing abusive members of *homo sapiens*. There are wild dogs to contend with, and an endless supply of non-native mongooses to trap. But the vigilance of Mr. Smith, his staff, and an often-anonymous cast of supporters is paying off.

The Laysan albatross, known affectionately as the "goony bird," has returned, and this spring, with the mongoose population in retreat, there was one fuzzy, brown chick — a first, says Dave Smith.

Few resolute four-wheel fans still spend their energies chipping at the barricade. "I let 'em work and work and work for six months," says Mr. Smith. "Then I love going out there with the front-end loader and piling monstrous rocks in front of the gate."

MICHAEL BUCK *(left)*; MAILE SAKAMOTO


Disposab
THE RE

le Diapers Are OK

AL WORLD

Disposable diapers have been the quintessential symbol of the throwaway society, the garbage crisis, and the environmental legacy we're leaving our kids. But they deserve to be a symbol for vigilante environmentalism instead.

By Patricia Poore

THE YEAR IS 1989. I AM IN NEW YORK, BUSY WITH THE LAUNCH OF A MAGAZINE THAT WILL COVER THE ENVIRONMENT. I DON'T CONSIDER MYSELF AN "ENVIRONMENTALIST," IN THE ACTIVIST SENSE; I WANT MY NEW MAGAZINE TO BE AN INDEPENDENT VOICE. I AM BRASH ENOUGH TO DISCLOSE THAT MY FATHER WORKS IN THE CHEMICAL INDUSTRY, AND IRONIC ENOUGH TO CALL THE MAGAZINE GARBAGE. YET, I LIVE IN A TIME WHEN CONVENTIONAL WISDOM HAS IT THAT INDUSTRY, RUN BY MEN WITH QUESTIONABLE MOTIVES AND MORALS, IS A CONSTANT THREAT TO LIFE ON EARTH. WHEN "CARCINOGEN" IS A HOUSEHOLD WORD. WHEN GOVERNMENT AND INDUSTRY ARE, LEGITIMATELY AND NECESSARILY, CLEANING UP THE POLLUTION PROBLEMS CAUSED BY PAST IGNORANCE. I AM ASSAULTED BY MEDIA STORIES: THERE IS THE OZONE HOLE AND THE RISE IN SKIN-CANCER RATES. THERE IS ACID RAIN KILLING TREES AND

PHOTOGRAPHY BY BRIAN SMALE

obliterating ancient monuments. There is dioxin, the Frankenstein monster of modern chemistry.

Especially, in my baby-boomer zeitgeist, there is America: rapacious, gluttonous America, a nation of "consumers," not people, where disposables are a birthright and the throwaway society has evolved to grotesque caricature: More! More! And nowhere to put the trash.

And so I have no doubt (in 1989) that disposable diapers are both a material problem and a fitting symbol. Here we are, wrapping our *babies* (for no good reason!) in that which will destroy their future: *nonbiodegradable garbage!*

My husband and my sitter had been buying disposables on the sly for several months.

IT IS SPRING OF 1992. I AM no longer in New York, and I am a mother. I am three years into a difficult environmental education, and I have a headache. The reporter from *House Beautiful* guilelessly asks me questions about car emissions and politics and the finances of the magazine without blinking. She waits for the end to ask the question for which she feels she has to apologize, because this silly thing, of all things, is the hypocrisy issue: What kind of diapers do I have at home?

"YOU HYPOCRITE! GIVE ME ONE GOOD REASON WHY I SHOULD KEEP SUBSCRIBING, WHEN YOU YOURSELF ARE FULL OF SHIT!!" screeched one of the many condemning letters I got when my answer — Pampers — appeared in print. I was taken aback, more by the venom than by the concern. Angry, hysterical, holier-than-thou ravings over *diapers*, a tiny part of the solid-waste stream, arguably not an environmental problem at all. I had assumed that, like me, people were aware of lifecycle analyses of diapers, of their becoming a non-issue — clearly not the case. Consumer mentality wins out even among those supposedly supporting the environment: I had not changed an aspect of my "consuming" (in this case, diapers), therefore I was not fit to edit an environmental magazine. I received not a single letter asking for my reasons, never mind congratulating me for telling the truth.

Hyperbole & Hypocrisy

I HAD STARTED WITH CLOTH DIAPERS, MOSTLY BEcause I'm old-fashioned. (I buy Ivory soap, too, and I hate digital clocks.) We had diaper service, which seemed not only more convenient but probably more environmentally sound: Delivery was efficient in a dense Brooklyn neighborhood.

It was not entirely a free choice, however. There were those press kits from factions in the cloth-diaper business, complete with quotes from So-and-So, M.D., about how dangerous disposable diapers are, how they cause allergic reactions and diaper rash; photos of genital infection and descriptions of mutilation from impacted polymer beads that somehow came loose of the diaper and lodged in the baby's little orifices. Truth is, I was *terrified* to use disposables.

I was programmed to think that cloth would be cheaper. But I learned differently, and marvelled that not one of the (male) researchers who compared cloth and disposables penny for penny pointed out that the Velcro-closure diaper wraps cost $10 to $16 each, that you need at least five because they get wet, and that the baby outgrows four or five sets of them.

I hate to admit what a chicken I was, but I let myself be bullied by image, too. How else to explain that the disposables bought for travel days were locked in the glove compartment, or hidden in my luggage, so no one would see them?

BY THE TIME WILL WAS TEN MONTHS OLD, MY HUSband and my sitter had been buying disposables on the sly for several months. (I wonder if any of the researchers figured *that* phenomenon into cost analysis: add to the diaper service the unrecorded price of disposables bought by daddies, sitters, and grandmas!) It seemed the "plastic" diapers lasted through long trips to the park. Cloth diapers, sloppy, cold and wet in 45 minutes, couldn't be changed outdoors in winter. Will liked the disposables better, too: They were dry and compact. Reluctantly (because I still believed in diapers-as-symbol, and I still suspected, then, that cloth was more environmentally benign), I joined the vast majority of parents who know a good thing when they see it. Anyway, in Gloucester our house was miles out of the way of the closest service.

As time went on and my perspective deepened, I became more confident that my decision wasn't much of a compromise. Apparently, there is very little difference, if any, in the cradle-to-grave environmental impact of cloth vs. disposable diapers. (See the accompanying article.) Even banning disposable diapers would have an imperceptible impact on the waste stream.

To the GARBAGE staff, the diaper story is old news. But that's not the case among the general public, as the *House Beautiful* story illustrates. Facts and even common sense may tell one story, but a

Cotton vs. Disposables: What's the Damage?

by William Rathje & Cullen Murphy

WE TEND TO THINK OF DISPOSABLE diapers as being made of plastic, though in fact by weight only about 8 or 9 percent of a disposable diaper — the waterproof backsheet — is plastic. About three-fifths of a disposable diaper's constituent weight is plain cellulose, which goes into the diaper's absorbent padding; the padding is infused with a nontoxic polymer that turns into a gel when contact is made with urine. The liner padding, fasteners and a few other components together account for about a quarter of the diaper's weight.

In considering the pluses and minuses of disposable and cloth diapers, the major bones of contention have involved these matters: the relative *amount of energy* that the use of each diaper requires; the relative *volume of raw materials* that the use of each type of diaper requires; the relative *volume of discard*; the relative *amounts of water* consumed; the relative *threat of pollution*; the relative *threat to public health*; and the relative *cost per diaper*.

During the past decade and a half, there have been a number of studies that bear on these issues. Most were commissioned either by companies that manufacture disposable diapers, such as Procter & Gamble, or by the National Association of Diaper Service Industries, which, for obvious reasons, promotes the use of cloth diapers. The studies are all examples of what is known as "product lifecycle analysis" or "cradle-to-grave analysis," a controversial and slippery methodology in which an attempt is made to gauge a full range of costs that arise from the creation, use, and disposal of a product. The two sides are at loggerheads on many issues. But let's look at what almost everyone can agree on.

Bill Rathje's column "Beyond the Pail" will reappear in the next issue of GARBAGE. This commentary on diapers was adapted from *Rubbish! The Archaeology of Garbage* (1992), by William Rathje and Cullen Murphy, with permission of HarperCollins Publishers.

Energy, Water, Pollution

FOR DISPOSABLE DIAPERS, THE BULK OF the energy use occurs during manufacturing, and at this stage, there is also a likelihood that some pollution will occur. The resources required for disposable diapers are mostly renewable — cellulose, from trees — but plastic, too, goes into the diaper, and it goes into the packaging as well. The manufacturing process requires large amounts of water, some of which becomes waste water. Disposable diapers obviously create more municipal solid waste than cloth ones do, and they create a possible pollution problem when they are dumped in landfills (a third of all diapers contain fecal matter, and all contain pathogens, at least initially) and perhaps even when they are incinerated. As for expense, if one simply looks at per-diaper cost, disposable diapers drain the pocketbook faster than cloth ones do (the per-diaper cost for disposables is about 25 cents, versus 7 to 9 cents for cloth diapers laundered at home and 13 to 17 cents for diapers from a diaper service).

For cloth diapers, the largest amounts of energy are consumed in the growing of cotton (which requires large quantities of irrigated water and pesticides) and then in the 180 or so washings that the average diaper laundered at home goes through in its lifetime. Diapers last more than twice as long at home as they do in the employ of diaper services (which only about 15 percent of households on a cloth-diaper regime use), largely because services, for aesthetic reasons rather than purely practical ones, limit the number of times they will reuse a cloth diaper. The material resources required for participation in a cloth-diaper system (cotton, primarily) are almost completely renewable — but don't forget about the chemicals used to make detergent (or the ones used to grow cotton, for that matter). The washing of cloth diapers requires vast amounts of water and turns the water filthy; it all goes into the sewage system. Diaper services, because of economies of scale and other efficiencies, use somewhat less energy per diaper and produce less dirty water per diaper than is the case with home laundering.

When everything is added up, which diaper regime comes out ahead, environmentally speaking? That's the rub: It is impossible to say. Minor differences in assumptions — for example, over how often people who use cloth diapers double them up — cause reverberations that deflect the analyses apart. The most striking fact overall, however, is how small the differences between the two diaper systems really are, no matter whose studies one accepts.

symbol is not so easy to destroy. Consider the recent poll that asked, "What are the most pressing garbage problems?" According to that report on solid-waste management released in June by the American Society of Mechanical Engineers, both the public *and the media* are still most concerned about disposable diapers and aerosol containers. (Mechanical engineers were polled, too; their collective answer — "paper" — was on the mark. Almost any answer, from yard waste to construction debris, or even plastic packaging, would have been more accurate than the public's perception.) Why *are* we so stuck on diapers as symbols?

Well, diapers are easy to hate, distasteful and all too prevalent as litter. Second, because they are related to babies, they subconsciously prick the fear that we are not leaving the planet in very good shape for the next generation. Third, they are relatively new; it's easy for someone who hasn't used them to assume it would be no problem to go back to the cloth diapers of the 1960s. Fourth, the visible, outside layer is plastic, which has its own image problems. Fifth, and this gets murky, it's a women's issue. I don't mean that male environmentalists picked diapers to be a symbol; quite the opposite. I mean that women, subtly caught between convenience and the desire to protect the Earth, feel that throwaway diapers are something we *should* give up.

Questionable Tactics

I COULD END THIS ARTICLE HERE, WITH MY PERsonal anecdote and Dr. Rathje's testimony. But diapers have become a bigger issue for me. For a time, they simply lost, for me, their role as a symbol for waste. But I have recently begun to think

And, in absolute rather than comparative terms, one is not dealing with a major blight upon the land in either case.

For example, regardless of which type of diaper requires the most energy, the overall amount of energy under discussion is not very large. In real terms, and using high-end estimates for both energy consumption and number of diapers worn, all the energy invested in the disposable diapers that a typical child uses in a year is equivalent to about 53 gallons of gasoline. That is what would be consumed by driving from Boston to Little Rock. We may never determine conclusively which kind of diaper, all things considered, is the more efficient, but *neither* kind is a major drain on our nation's energy resources.

The Garbage Concern

WHAT ABOUT THE FILLING-UP-OF-the-landfills issue? Critics of disposables always hammer home the same point; to quote Carl Lehrburger, author of the two key pro-cloth diaper documents: "No other single consumer product — with the exception of newspapers and beverage and food containers — contributes so much to our solid waste." That statement seems like quite an indictment, though in fact it may be a little like saying that birds would be the biggest animals on earth if there were no mammals, reptiles, or fish.

Nevertheless, because disposable diapers loom so large in casual litter, one tends to assume that they loom large in garbage as a whole. They don't. Excavations of recent strata in nine U.S. landfills by the University of Arizona's Garbage Project reveal the volume taken up by disposable diapers to vary from .53 percent to 1.82 percent. Disposable diapers may be a big-ticket item in landfills compared with toothpicks and check stubs, but they are simply not in the same league with paper of various kinds (newspapers, expecially) or items such as food waste, yard waste, and construction and demolition debris, all of which fill up landfills at a rate many times greater than that of diapers. Given all the other, larger targets of opportunity, it may be misguided to draw a bead on disposable diapers. It is certainly an illusion to believe that eliminating disposable diapers would have anything but an imperceptible effect on the larger garbage picture.

As for the possibly deleterious effects of landfill diapers on public health, the issue does not merit great concern. Even if disposable diapers do represent a problem, their addition to a landfill does not suddenly poison a pristine environment. The so-called "bioload" of a typical landfill — the census of its microorganisms, many of which are pathogenic — is so enormous that the contributions made by diapers are relatively insignificant. Landfills already receive about 20 percent of the sludge from America's sewage treatment plants. They receive 8 percent of the septage from the country's septic tanks. Normal household garbage fairly brims with food waste, with the residues of personal hygiene, with pet feces. Medical waste of every imaginable kind finds its way into landfills, even if much of it should not.

It is worthwhile, still, to figure out whether adding diapers to landfills makes any noticeable difference. Trying to do so seems to have turned into one of environmental science's minor cottage industries. In the past 15 years, scores of scientific studies have been done on the subject. They yield a picture of diapers in landfills in which most of the microorganisms that diapers contain die off over time, and the few that do not die tend not to migrate very far. The propensity of bacteria and viruses in diapers to expire in landfills has been widely documented.

of them as a symbol for vigilante environmentalism.

I did not like the tactics of the anti-disposable diaper crowd. There is only one word for their methods: propaganda. Ironically, one of their claims is that disposables were a frivolous product shoved down the throats of American parents by corporate brainwashing —specifically, that Procter & Gamble used the relentless mind-control of advertising to sell the specious concept of "convenience." I can tell you from experience: All P&G needed to convince me was their product. It was the cloth-diaper business that was doing the brainwashing.

Don't get me wrong. Cloth diapers are a legitimate choice; they may be preferred on aesthetic grounds, or for reasons of cost. (They're certainly cheaper if you have more than one baby, and wash the diapers yourself.) For households who have an overall commitment to reduce waste, they are the right choice and, yes, an important symbol. But no one should be forced to choose them because of propaganda, and no one should think that disposable diapers are a major blight on the environment. That simply doesn't fit the facts.

I feel angry and betrayed by tactics, used by those supposedly preaching nurture, which take unfair advantage of a mother's concern. Here is the worst part: The episode has made me doubt other environmental symbols, other unscientific dogma, other questionable means used in service to righteous ends. Because it touched me personally, the bogus diaper debate has focussed my attention on vigilante environmentalism: "Ignore the facts! We've got a Good Cause here, and if you don't get in step, we'll make you pay."

It is a tactic that has been used in arenas much more critical than diaper choice. Used against waste managers, used against business, it has been a factor in boycotts, smear campaigns, and NIMBYism. This part of the environmental scene scares me, because it creates apathy (as people get sick of being made to feel guilty), a backlash (as rhetoric is finally questioned), and a cessation of debate (as companies go silent in disgust of the angry mob).

Debate It to Solve It

I HAVE COME TO QUESTION MANY OF THE assumptions I had in 1989; the name of this magazine is as ironic as ever in its jab at conventional wisdom. Also, my understanding of the difference between a garbage problem and an environmental problem has sharpened. Garbage (household and office waste, food and yard waste, most construction debris, old bicycles: the bulk of what goes to a landfill) is not a global environmental problem. We don't make more of it than we have places to put it or technology to manage it. Garbage is a political and economic problem with a local environmental impact, largely (these days) cosmetic. (No, I don't want to live next door to a dump, either; but disgust is not a threat to life on Earth.)

With better perspective now, I have had to accept (swallowing hard, because it's a complex issue, one that all 50 simple things together won't solve) that worldwide population growth is the environmental problem that ought to have our highest priority.

One change of heart has been more optimistic. I've learned in the past three years that America need not be categorically defined as the decadent society environmentalists say it is. (They love to tell us the "green movement" is stronger overseas; in my opinion, that's because degradation was worse there . . . dare I express my thought that it's also because Americans reflexively spit out anything that smacks of fascism?) Many problems can be solved in a country with both technology and regard for human rights. We have bountiful resources and an already longstanding commitment to wilderness preservation. We have women's choice and a stable birthrate. Imperfect though it may be, we have the best environmental track record in the world. Most importantly, we have the luxury of affluence, which even allows us to consider the environment and the future as priorities.

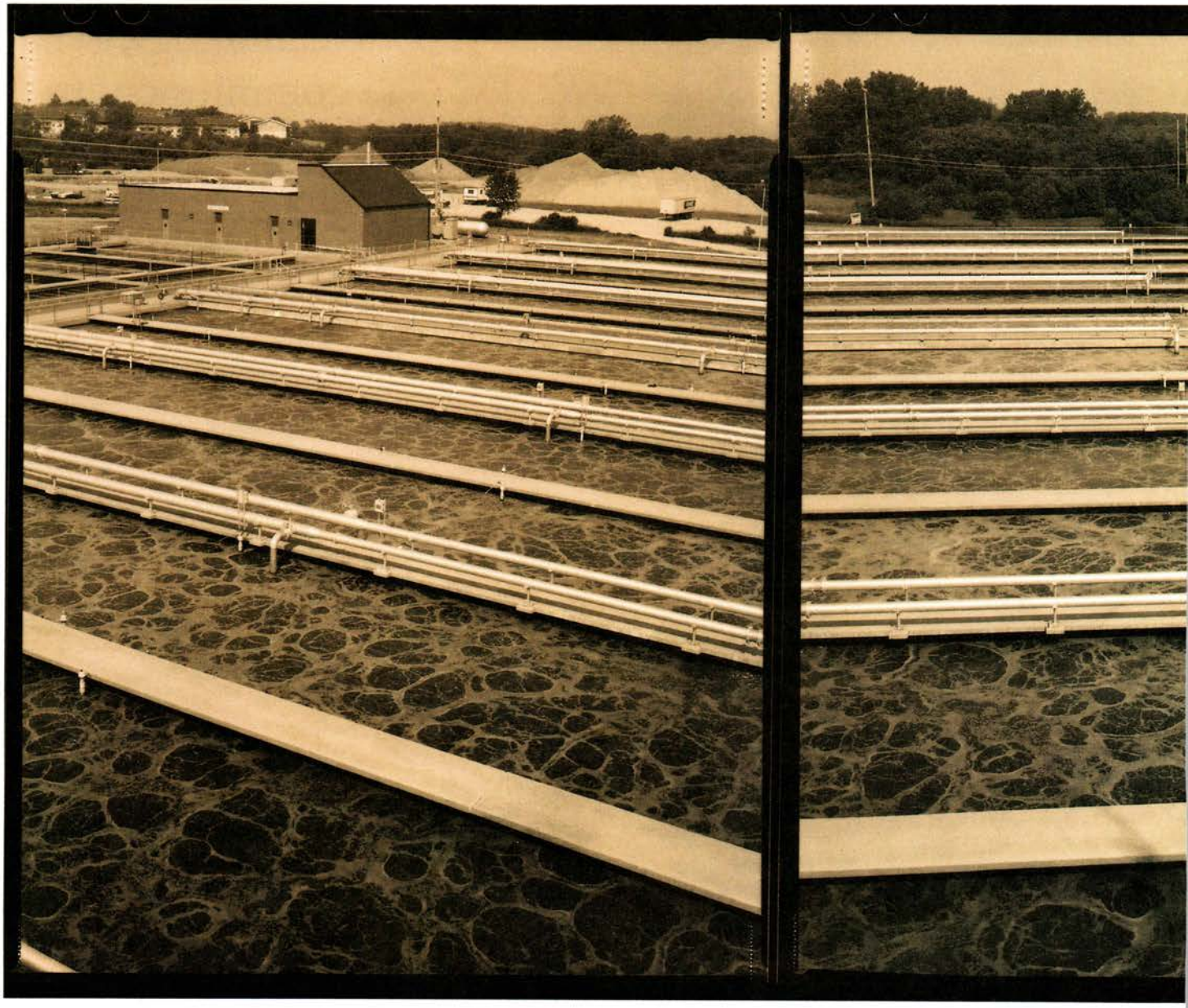
America has the luxury of affluence — and technology, a commitment to wilderness, a stable birthrate.

I'm no Pollyanna; in the GARBAGE office, much of what we read is an indictment of business-as-usual, an endless litany of accusation: what industry and consumers and waste managers are doing wrong, what we need to clean up. A lot of it is true. That it's under debate is another reason I believe that America can lead the world into a more environmentally benign future.

Environmental problems will not go away. To solve them, we have to shake ourselves out and make sure we're thinking straight. We have to stop being bullied into political stands that have little to do with science or the real world. We have to stop allowing ourselves to be distracted by petty symbols like diapers, and find the courage to tackle real problems.

S L U D

THE CHINESE CALL THE HUMAN FECES THEY'VE LONG TOTED TO THE FIELDS "NIGHT SOIL." AN INSPIRED EUPHEMISM, PERHAPS. IN THE U.S., WE TREAT it first and call it sewage sludge: the solid residue of the bacterial digestion of human manure. Believe it or not, *treated* sludge is benign smelling, and a world-class soil conditioner and fertilizer. Best of all, it's quietly become a big recycling success story. Waste managers think you'd rather not hear about it. But, by putting sewage sludge on farm fields, we're closing a major resource loop — from farm crop to food to sewage to sludge to fertilizer back to farm crop. ■ As recently as 1982, 75 percent of this formerly fecal mass was wasted: Sludge was buried in landfills, abandoned in giant, terrestrial "lagoons," dumped in the ocean, or incinerated. Recycling has been pushed by the compelling need to do something with the 6.1 million dry tons of sewage sludge produced by the U.S. each year. And it's pulled by the fact that many farmers now recognize sludge as a great source of organic matter and the essential plant nutrients nitrogen and phosphorus. (Due to our enduring poop-phobia, treated sludge is mainly used as a food for feed crops and ornamentals, not for



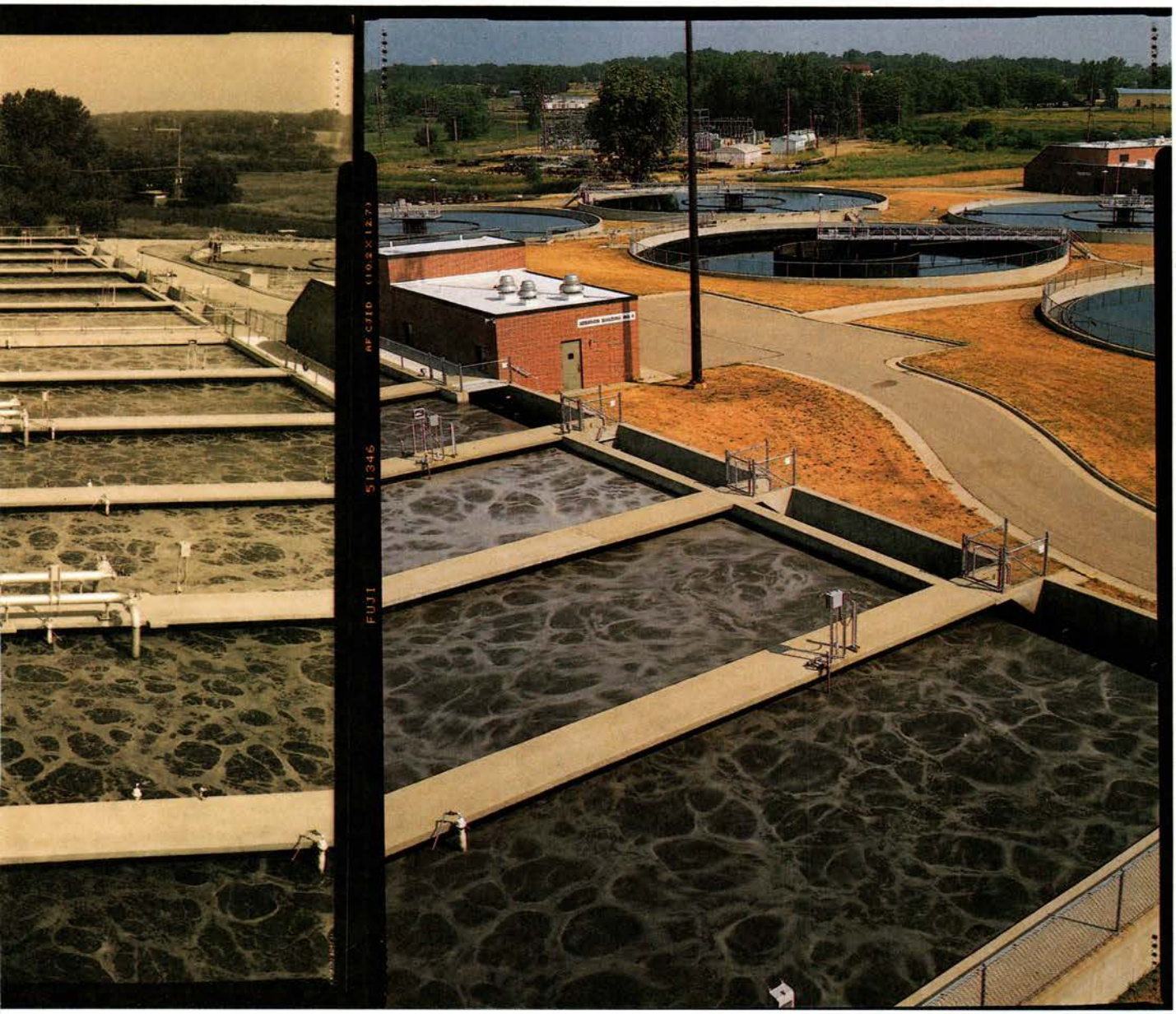
THE REAL WORLD

Did you know: Treated sewage sludge is already being used to condition farmland — and it's a recycling success story.

By David Tenenbaum

Photography by Paul Elledge

feeding your veggies.) ■ According to the most recent EPA survey, in 1988 the nation was recycling sludge at a 48-percent rate. That number is already history because New York City and New Jersey, responding to federal requirements, pulled the plug on their favored method of sludge disposal: dumping it in the Atlantic Ocean. Most of our recycled sludge — 42 percent of total production— is applied to farms, forests, and degraded land. Another 5.8 percent is bagged and sold or giv-



en to landscapers, highway departments, and consumers.

When you compare sludge's 48-percent recycling rate to the wimpy 13.1 percent of household solid waste that's recycled, and when you consider that some solid waste "recycling" is just junk material awaiting a market, you can see why I consider sludge one of this country's premier recycling successes.

But the glass is also half empty. Half of the nation's sludge still gets dumped. And then there are my friends, especially the ecologically correct ones. When I try to tell them about my new passion, I hear a predictable chorus: What about odor? What about disease? What about PCBs or heavy metals?

The short answer is that you can have problems if you screw up by allowing lead and cadmium, for example, to contaminate incoming wastewater. But many of these hazards can be prevented by intensive monitoring and sensible handling. And recent research indicates that heavy metals are unlikely to leach out of properly chosen and operated sludge fields (depending on pH and other soil characteristics, and application rates).

With the right processing, this waste can be diverted from landfills and recycled into farm fields. You, too, may find yourself becoming sympathetic to sewage sludge, once you know more about it.

Slogging into Sludge

SLUDGE, A RESIDUE OF THE SOLID PORTION OF MUNICIPAL WASTEWater, is produced at a sewage-treatment plant. Like most such plants, the one in Madison, Wisconsin, is adjacent to a wetland. (Sewage plants are located as low as possible so gravity helps wastewater flow toward them.) At the plant, a series of fetid "swimming pools" and white domes — both housing various treatment processes — announce the presence of Microbes at Work. Underground is a web of gargantuan pipes and pumps.

Wastewater arrives via an intake pipe that spews forth a gray soup of ingredients like water, urine, feces, intestinal bacteria, toothpaste, shampoo, paint, cleaners, and whatever else we pour down the drain. A good treatment plant separates this slurry into fairly clear water and clean sludge. Briefly, here's how:

When the "soup" arrives, gravel and sand settle out and scum is skimmed from the surface. Then water and the, ahem, "heavy materials" start going their separate ways. The primary sludge enters huge, bubbly tanks, where oxygen-loving (aerobic) bacteria feast on organic matter. Next it's piped to oxygenless "digesters" where anaerobic bugs devour stinky, ammonia-rich organic matter. (The methane that's released is burned for electricity to power Madison's plant.)

After about 20 days in the anaerobic digesters, the sludge is stabilized, the odor is gone, and the nitrogen has been transformed into nitrates (NO_3), an essential plant fertilizer. Although heat and chemicals inside the digesters kill most of the nasty bacteria, sludge does contain some pathogens. But not a lot. For example, while one billion fecal coliform bacteria (generally nonpathogenic microbes measured to indicate treatment effectiveness) were found in each 100 milliliters of undigested sewage sludge, the amount ranges from 30,000 to six million in *digested* sludge. The stuff is no more fearful than a cow pie.

"In all the years that sludge has been put on agricultural land, there's not been a [single] documented case where someone has developed an infection due to land application," says Art Peterson, a veteran sludge scientist.

In my high school, the bathroom walls weren't scrawled with gangland graffiti. Instead, they carried a bit of sophomoric culinary advice: "Flush twice — it's a long way to the cafeteria." Now, after I flush twice, it goes to the Madison treatment plant, where a pioneering recycling program has been feeding sludge to farmland since 1974.

After the winter's freeze out, when the soil is thawed, tankers truck liquid sludge over the short haul to nearby farmland. (To cut transportation costs, some plants dry their sludge.) In the fields, specialized tanker-tractors weighing 50,000 pounds (fully loaded) gulp down 3,500 gallons at a serving, and inject the liquid about eight inches into the soil. The applicator bequeaths rough-

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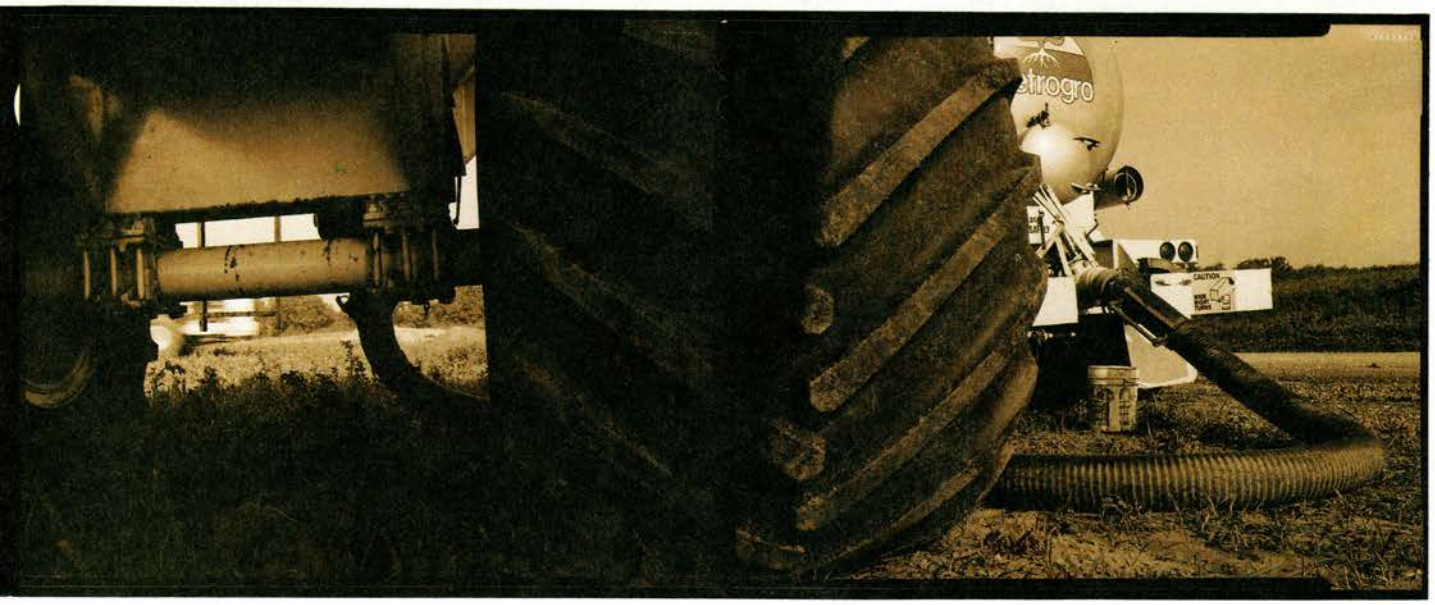
BASED IN MADISON, WISCONSIN, DAVID TENENBAUM WRITES ON SCIENCE, HEALTH, AND THE ENVIRONMENT.



Sludge is produced at a sewage treatment plant, like the one in Madison, Wisconsin (overleaf). After several weeks of treatment, sludge is transformed into an effective plant fertilizer. In Wisconsin, tanker-tractors apply liquid sludge into fields for growing animal feed (above).

ly 12,000 gallons to each of the eight to ten acres it covers daily.

Hereabouts, if you were to drive past a field that's freshly treated with sludge, you wouldn't notice much more than dark, moist soil. Take a whiff and you'd get an earthy aroma, similar to compost. Because of the sewage district's attention to detail, you wouldn't notice any of the black slurry — even the spills from decanting from tank to tank are captured in buckets.

Growing plants, however, get a good dollop of what Art Peterson calls "black gold." Experiments by this University of Wisconsin-Madison soils professor show that sludge can entirely replace commercial fertilizer on field corn (corn grown for cattle and hog feed). Unlike chemical fertilizers, humus-heavy sludge not only promotes essential bacterial action in soil, it also improves soil structure, thereby increasing water infiltration and decreasing runoff.

Publicity is critical to all sludge-recycling programs. When the Madison district began spreading sludge in 1974, "recycling" was just entering common parlance, and nobody was sure how local farmers would react to a black slurry from a sewage plant.

A new name was key to Madison's PR program. "Sewage sludge evokes very negative images," understates recycling program director David Taylor. So the district held a contest for a euphemism and applied the winner, "Metrogro," to Madison's processed sludge. The district emblazoned the flashy name on its stainless-steel tankers, which are considerably cleaner than the semis now unloading at your supermarket.

The name game is catching on nationally. In December 1990, a professional group called the Water Environment Federation sponsored a national competition for a moniker less fearsome than "sewage sludge." Are you ready for "biosolids"? Researchers for *Webster's* have opened a file on "biosolids" for possible incorporation in a future edition.

In Madison, at least, the PR campaign worked. The district hauls about 10,000 tons of dry solids per year, enough to cover about 4,000 acres. Farmers want more. Taken together, they've put up about 30,000 acres for treatment. Those who are lucky enough to do a deal for Metrogro aren't altruistic recyclers: Farmers get all the nitrogen and phosphorus they need for field corn at just $7.50 an acre. If purchased in chemical fertilizer, these elements would cost roughly $40 per acre per year. (A sludge farmer might need about $10 for additional potassium.)

The big picture: According to soil scientist Art Peterson, one to two percent of the nation's cropland — much of which has been depleted by erosion or chemical-intensive agriculture — could absorb the entire national output of sludge. And a minor irony: If sludge recycling catches on, it will transform the kitchen garbage disposal from its perch on the acme of superfluous gadgetry to a recycling highway. Instead of shlepping orange rinds and coffee grounds to the compost heap, we would sluice them down the drain and hit the disposal switch. The sewage-treatment plant will do the rest. (Of course, by circumventing the compost pile you'll miss out on a valuable soil ammendment for your backyard.)

Dealing with Pollutants

As I stand in the application field at the Department of Correction's prison farm in Oregon, Wisconsin, watching a tanker-tractor injecting sludge into the soil's root zone, I hear the howl of the applicator's engine. And I imagine the even louder whine of my friends: What about all the household and industrial toxics which are flushed down drains, to join the 40 million gallons of wastewater that flows daily into Madison's treatment plant? What about feces-loving pathogens and parasites?

With sewage treatment, much of the incoming slop decomposes into benign substances. Take glucose from food, which if left untreated would travel with wastewater into lakes and rivers, depleting oxygen. At the sewage plant, incoming glucose is bro-

In central Illinois, a landscape scarred by strip mines is being restored with treated sludge. Sludge-treated soil is capped with grasses (right), while untreated soil remains barren (left).

ken down by microbes into carbon dioxide and water. But some components, like heavy metals and PCBs, do remain intact.

To appreciate the hazards of accepting polluted wastewater, the Madison district need look no further than the lagoons where it still stores sludge that accumulated for three decades before recycling began in 1974. Those lagoons are so polluted with cancer-causing PCBs that Madison became the nation's first sewage district to be placed on the federal Superfund list for cleaning up hazardous-waste sites. The district may be compelled to burn millions of gallons of contaminated sludge at a cost of $50 million to $100 million. "Whether your standards are financial or environmental, it's a hideous prospect," says district chief engineer James Nemke.

The lesson is simple: Once heavy metals, chemical pesticides, or other nasties flow into the waste stream, it's very tough to get them out. That's why the district requires industries to *pretreat* their sewage. Some manufacturers in the Madison district have substituted less-toxic materials, thereby cutting toxic effluent. Others use precipitation to remove heavy metals from effluent. (Precipitation converts a toxic material from a soluble to an insoluble form, which settles out of wastewater.)

Nationwide, metal concentrations in sludge are also falling, a reflection of the recycling imperative. In the mid-1970s, battery, plastics, and electroplating industries upped the cadmium level in Chicago's sludge to 280 to 300 parts per million (ppm). By 1992, those numbers fell to 40 ppm — much of it from background sources such as tire particles flushed down street sewers.

Quality control in Madison and elsewhere is ensured by a network of tests and government regulations. Each day, newly processed sludge is analyzed for total solids and nitrogen content. Each month, the district checks for phosphorous, potassium, cadmium, and other metals. Every other month, it looks for 39 more metals, pesticides, herbicides, PCBs, and bacteria.

Madison tests the surface layer of sludge-treated soil at least once every three years. (Because heavy metals are much more mobile in acidic soil, sludge-treated fields must be maintained at a pH of 6.5 or higher.) Deeper soil samples and plant tissues are analyzed for cadmium, copper, lead, nickel, and zinc. Before and after each application, the district tests more than 750 private wells for their pH, as well as zinc and nitrate. One significant change has been detected: an increase in nitrate levels. Credit wider use of nitrogen-heavy commercial fertilizers.

PCBs? These cancer-causing compounds bind tightly to sludge and degrade *extremely* slowly. The federal maximum of PCBs in sludge intended for land application is 50 ppm. In 1991, Madison's sludge averaged 5.5 ppm.

Despite the concern about heavy metals in sludge, they too tend to stay where they are, as long as the soil isn't too acidic (above pH 6.5). In 1986, Art Peterson tested heavy-metal levels in sludge for the Milwaukee sewer district. He concludes, "Movement of these metals into groundwater seems practically impossible." As for crops grown from sludge-treated soil, when Mr. Peterson tested corn he found lead levels were below the detection limit of 1 ppm.

Pathogens? Most are killed by chemicals and heat in a treatment plant's anaerobic digester. To prevent the survivors from being eaten by those on top of the food chain (you and me), sludge is kept out of the vegetable patch. Feed crops which receive sludge are dried, ground, and eaten by animals, significantly cutting a disease-causing organism's chances of finding its way to us.

As my friends keep caviling about the hazards of treated sludge, I've decided the only good answer is this: If you don't want pollutants distributed on the fields that grow your food, keep them out of your wastewater.

Healing the Land

IN CENTRAL ILLINOIS, WHERE FARMS ARE MEASURED IN THOUsands of acres, human waste is repairing a human wasteland.

Following World War II, in this flat-as-a-pool-table farmscape 200 miles southwest of Chicago, strip miners cast aside dozens of feet of "overburden" from entire square miles — all in pursuit of a four-foot thick seam of coal. After the mining companies ripped out the coal, they left behind a scarred landscape with inexplicable hills and odd-shaped lakes covering nearly 16 square miles. Nobody seemed to care that the "overburden" comprised some of the world's most productive farmland.

On 345 acres of tailings piles, nothing grows: no trees, no grasses, no shrubs. These enormous mounds of subsoil, rock, and low-grade coal were left by miners when they departed more than 30 years ago. With a pH less than 3, not even soil bacteria tolerate the highly acidic piles. Attempts to reclaim tailings piles with chemical fertilizer have failed, partly because there's no organic matter to support essential soil microorganisms.

But Chicago's Water Reclamation District is working a miracle. Like Lazarus, the refuse piles are springing back to life. And they are being served generous dollops of sludge.

It's not a pretty process: scalping the bizarre hills left by strip miners into an erosion-resistant landscape, then covering them with thousands of tons of black sludge. But it works. Each acre of the district's largest pile, which covers 110 acres to about 50 feet deep, was covered this past summer with 1,000 dry tons of sludge and 70 tons of agricultural lime. Test plots, begun in 1987 on similar tailings piles, have shown that plants flourish once sludge restores organic matter and neutralizes the acid. The reclaimed refuse piles are now capped with a crop of grasses and legumes — feeding grounds for songbirds and small mammals.

Success at reclamation aside, the Chicago district came here merely to cheaply dispose its sludge, which accumulates at the rate of 600 dry tons daily. In the 1960s, Chicago realized that it was running low on landfill space, so it began talking with Fulton County authorities about using former strip mines for disposal. By 1976, the district had purchased over 15,000 acres of old strip mines.

At first, the district barged liquid sludge to the area, but in 1984 it shifted to cheaper-to-transport dry sludge, which has a consistency like the topping on a crumb cake. While the tailings piles get one enormous dose of sludge, about 2,500 acres of *mine soil* — a heavily compacted goulash of topsoil, subsoil, and rock — receive about 25 dry tons every few years. One year after treatment, the mine-soil fields are leased to farmers for growing hay, rye, corn, soybeans, and wheat (for livestock consumption).

Though the tailings piles have returned from the dead, crops grown on *them* will not be harvested. The piles will, however, be monitored indefinitely for acid formation and pollution migration. It's possible that future treatments (like adding more lime) will be needed to keep the grass green on the tailings piles, and the waters clear in the lakes below them.

An imperfect miracle, but a miracle nonetheless. To my eye, this piece of planet Earth is far more healthy than it's been for decades. All thanks to sludge. My romance with sludge has gotten so compulsive that I can imagine myself scribbling on the bathroom wall: "Flush twice, it's a long way to the corn field."

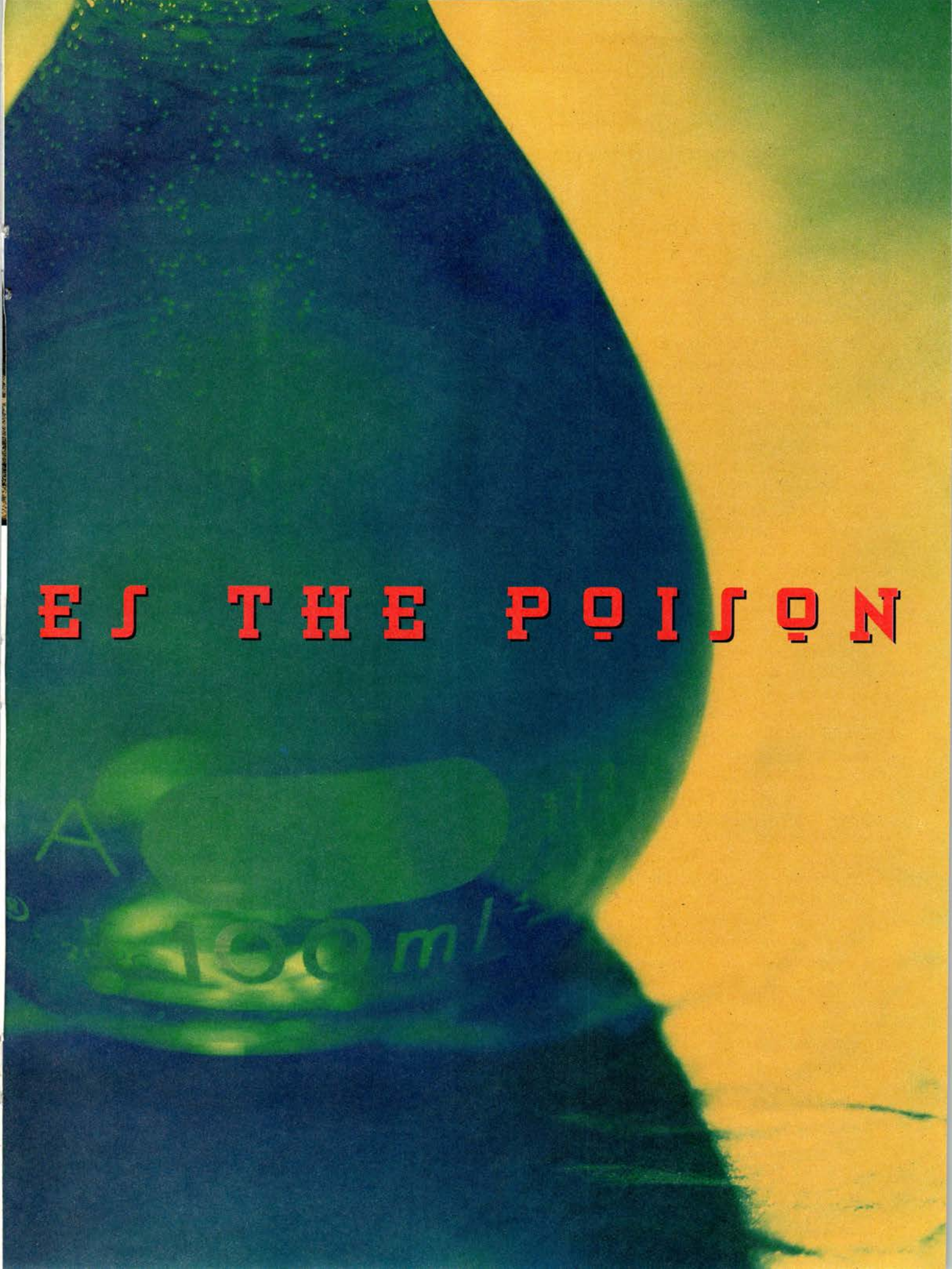
THE DOSE MAK

BY DR. ALICE OTTOBONI

PHOTOGRAPHY BY ABRAMS/LACAGNINA

UNDENIABLY, WE'VE GOT PROBLEMS — THE SIDE EFFECTS OF OUR ever-increasing human population. People and wildlife species are competing with each other for limited resources. Human needs have resulted in such environmental problems as urban sprawl, mountains of garbage, groundwater contamination, air pollution, even the possibility of human impact on ozone depletion and greenhouse warming. ➨ Seeing this, people react by looking for a villain they can label. The word "chemicals" has become one such label. People have come to think that the word means "poisons made by humans" that are fouling our water, our air, our food, and all the reaches of our global environment. While some chemicals *are* poisons, "chemical" and "poison" are not synonymous. Chemicals are the substances from which all things in the physical world are composed. Everything is chemical. Poisons, on the other hand, are a small group of chemicals that vary widely in origin, structure, use, and so forth, but which have in common the ability to be toxic or lethal in very tiny quantities. Any chemical can be toxic under some set of conditions, but relatively few are poisons. ➨ Understanding what makes chemicals toxic can help lessen an unreasoning fear of chemicals that has too often propelled us into hasty actions, which may not even provide a remedy. Poison paranoia impedes rational thinking about environmental chemicals. For solutions that provide real benefit, it is critical that scientific knowledge and a perspective free from prejudice be present.

M. ALICE OTTOBONI, PH.D., WAS STAFF TOXICOLOGIST WITH THE CALIFORNIA STATE DEPT. OF PUBLIC HEALTH FOR OVER 20 YEARS. CURRENTLY SHE LECTURES, WRITES, AND CONSULTS IN THE FIELD OF TOXICOLOGY. HER BOOK *THE DOSE MAKES THE POISON* (VAN NOSTRAND REINHOLD) IS IN ITS SECOND EDITION.


ES THE POISON

eople question toxicological precepts, such as that every chemical, with a few rare exceptions, has some level of exposure below which no adverse health effects will occur. If a chemical has no toxic effect, there is no experiment that can prove the fact ... it is not possible to prove a negative.

THE DOSE

A PREVALENT MISCONCEPTION IS THAT A CHEMICAL HARMFUL IN any amount is harmful in *every* amount. Or, to paraphrase Gertrude Stein, "A poison, is a poison, is a poison." Nothing could be further from the truth. Every chemical has some set of exposure conditions in which it is toxic and, conversely, every chemical has some set of exposure conditions in which it is not toxic.

All effects of chemicals — beneficial, indifferent, or toxic — are dependent on how much chemical is involved (dose) and how often during a specific period of time the exposure occurs (time). This dose—time relationship gives rise to two different types of toxicity that must be distinguished from one another: acute toxicity and chronic toxicity. The *acute toxicity* of a chemical refers to its ability to do systemic damage as a result of a one-time exposure to relatively large amounts of the chemical. Acute toxicity is the concern, for example, when children are exposed to some household product left within their reach or when some substance is accidentally spilled during transportation and neighborhood residents are exposed. The exposure is sudden and often becomes an emergency situation.

Chronic toxicity refers to the ability of a chemical to do systemic damage as a result of many repeated exposures, during a prolonged period of time, to relatively low levels of the chemical. Chronic toxicity is the concern with food additives, pesticide residues, or the effects of exposure to chemicals encountered in the workplace.

Acute and chronic toxicities are distinguished from one another because the respective symptoms usually bear no relationship to each other. With acute exposure, the ability of the body to dispose of the chemical (i.e., to metabolize, store, or eliminate it) is overwhelmed. The excess chemical is then free to attack the system. With chronically toxic exposures, the quantity of chemical is not sufficient to disrupt the first system it reaches, but is sufficient to damage a more sensitive system. Such damage is usually subtle and may not be expressed clinically for weeks, months, or years.

For example, acutely toxic exposures to chlorinated hydrocarbon solvents, such as chloroform and carbon tetrachloride, produce symptoms related to the central nervous system: dizziness, drowsiness, loss of coordination, unconsciousness. Chronically, the main effect of these solvents is liver damage. Acute arsenic poisoning manifests itself by severe abdominal pain, vomiting, diarrhea, bloody stools, and general paralysis. If poisoning is severe enough to cause death, it is usually the result of the exhaustion from the prolonged cholera-like (gastrointestinal) symptoms. On the other hand, chronic arsenic poisoning produces different symptoms such as thickening and scaling of the skin, wasting of muscles, liver damage, and injury to the blood-forming mechanism in the bone marrow. If death occurs from chronic arsenic poisoning, it is usually due to the liver or bone-marrow injury.

Chronic toxic effects cannot be predicted from a knowledge of the effects produced by acute exposures. (The fact that acute effects cannot be predicted from knowledge of chronic effects is also true, but of little practical significance — because information about the acute toxicity of a chemical always precedes and surpasses knowledge about its chronic toxicity.)

Not only do the symptoms of acute and chronic intoxication by a given chemical bear little relationship to each other, but neither do their relative potencies. A chemical that is highly toxic acutely is not necessarily highly toxic chronically and, conversely, a chemical that is of a low order of toxicity acutely is not necessarily low in toxicity chronically. For example, vitamin D is a chemical that is very highly toxic acutely, but chronically, in very small amounts, is essential for life.

Metallic mercury is a chemical that is just the opposite of vitamin D — acutely nontoxic and chronically toxic. Thus, the frantic mother whose child chews on the thermometer and swallows the mercury contents need have no fear: The mercury will be eliminated in the feces. Metallic mercury is extremely insoluble; thus, the amount of mercury absorbed from the intestinal tract is too small to cause poisoning. But if a child swallows the contents of a thermometer every day over a long period of time, the small amount absorbed each day could give rise to chronic mercury intoxication. (Metallic mercury must not be confused with mercury salts. The latter are very toxic both acutely and chronically.)

The tremendous importance of the dose—time relationship is well illustrated by the fact that every one of us ingests many lethal doses of many chemicals, both natural and synthetic, during

FROM THE EDITOR

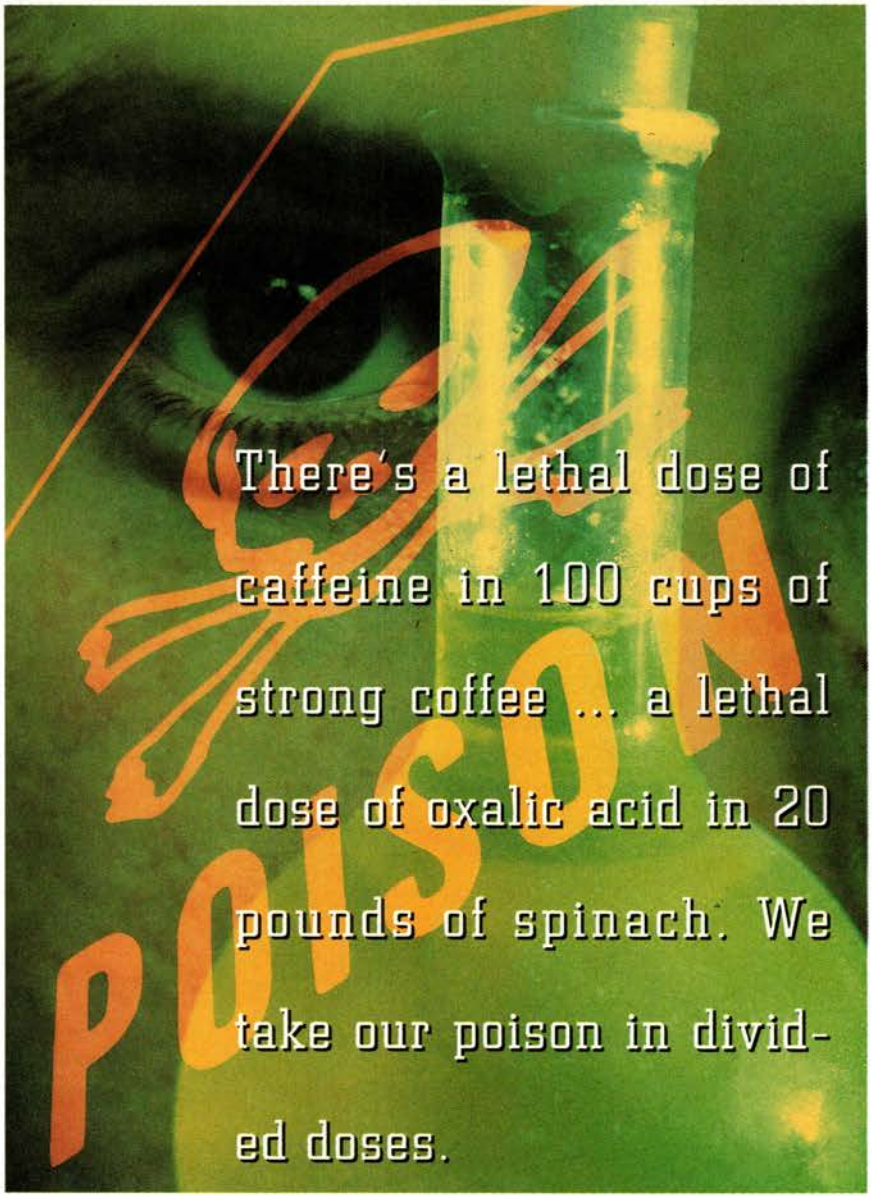
I HAVE BEEN QUOTED IN THE WALL STREET *Journal* and elsewhere as saying that a major impediment to sound environmental policy is the general lack of scientific understanding among both the public and legislators. I still believe that. But GARBAGE itself has not always done a good job of "speaking for science." I apologize.

The basic principles explained here will help you sort it out the next time a movie star suggests banning a beneficial chemical because it caused tumors in rats when fed to them in doses equivalent to 70 pounds a day for 40 years ... or the next time an environmental journalist exhorts, "when in doubt, choose the product with natural instead of synthetic chemicals." We are not questioning their motivations — only their science.

This feature is the first in a regular series. It owes its heading to Dixy Lee Ray, whose book *Trashing the Planet* poses the question "Who speaks for science?" in a strongly worded early chapter. — *Patricia Poore*

a lifetime. A shocking thought! But consider: There is a lethal dose of caffeine in approximately 100 cups of strong coffee. There is a lethal dose of aspirin in a bottle of 100 tablets. There is a lethal dose of solanine in 100 to 400 pounds of potatoes. There is a lethal dose of oxalic acid in 10 to 20 pounds of spinach or rhubarb. There is a lethal dose of ethanol in a fifth of Scotch or bourbon or gin. If all foods that contain potentially toxic chemicals were eliminated as food sources, people would suffer or die from malnutrition.

We survive because we do not take in 100 cups of coffee all at one time, or a whole bottle of aspirin, or a fifth of liquor. We take our poisons in divided doses — not all at one sitting. Our bodies can handle small amounts of foreign chemicals, both natural and synthetic. We metabolize them or excrete them unchanged without their doing any damage.



THE ROUTE OF ENTRY In contrast to its low oral toxicity, the vapors of metallic mercury are very toxic by inhalation. This fact demonstrates another toxicologic principle: The toxicity of a chemical depends not only on the dose—time relationship, but also on the route by which the chemical enters the body. The common routes are oral (mouth), inhalation (lungs), and dermal (skin). As mentioned, a child who swallows mercury from a thermometer will not be harmed. But a child who breaks the thermometer and lets the mercury fall into the pile of the bedroom rug, or into a crack in the floor, may be in danger. Metallic mercury is a volatile liquid — it is readily converted from the liquid form to the vapor form. The degree of risk from spilled mercury depends on the concentration of mercury vapor reached in the air.

NATURAL VS. SYNTHETIC CHEMICALS

ANOTHER COMMONLY HELD MISCONCEPTION IS THAT CHEMICALS made by nature are beneficial and chemicals made by humans are harmful. Actually, toxicologists recognize that nature is far more ingenious than man could ever be in devising toxic chemicals. A good example is botulin, the toxin produced by *Clostridium botulinum* organisms. One milligram of botulin (1/28,000 of an ounce) is capable of killing 20 million mice. It is estimated that the average lethal dose of botulin for an adult human is 2 micrograms, or 1/14 millionth of an ounce, a very, very tiny amount.

Toxic chemicals of natural origin, such as those produced by algae and other microorganisms, snakes, and plants, constitute a more common threat to wild and domestic species than do man-made chemicals. And natural and synthetic chemicals *together* are far less detrimental to wildlife species than habitat destruction resulting from encroachment by civilization.

Although man-made chemicals form a far smaller group than natural chemicals, they have become the symbols for the ecological damage that the human species is inflicting. One reason may be that humans *have* been irresponsible, often unknowingly, in their use and disposal of synthetic chemicals, the relatively new tools of civilization. Further, there is a sense that they can be controlled by humans; the synthesis of new chemicals can be prevented and the production of old ones can be halted. Mother Nature is not amenable to such control.

A second reason may relate to the intuitive (but erroneous) theory that humans and animals evolved with natural chemicals and are therefore adapted to them. This is not in accord with known adverse effects of natural chemicals in human, such as the carcinogenicity of certain mold toxins, or the high acute toxicity of

misconception is that chemicals made by nature are beneficial and chemicals made by humans are harmful. Toxicologists recognize that nature is far more ingenious than man in devising toxic chemicals. The distinction is irrelevant: Our bodies cannot recognize the origin of a chemical — nature or the lab.

chemicals produced by a variety of microorganisms and plants.

The distinction between natural and man-made chemicals is irrelevant: Living cells are not conscious units capable of deciding whether molecules that enter them are natural or synthetic. Our bodies cannot recognize the origin of a chemical. Our bodies can only distinguish between molecules they can use (for energy or to make more of themselves, more bone, more blood, etc.) and molecules they cannot use. The former we call biochemicals and the latter we call foreign (xenobiotic) chemicals.

Biochemicals may be natural or man-made, and foreign chemicals may be natural or man-made. The distinction exists for all living organisms, and varies among classes of organisms. What may be a biochemical for one class of living things may be a foreign chemical for others. For example, strychnine is a natural chemical produced by nux vomica plants. Thus, it is a biochemical for nux vomica plants, but a foreign chemical (and a deadly one at that) for animal species, including humans. Although strychnine (to use just one example) is a very toxic chemical for many species for which it is foreign, foreign chemicals are not of necessity harmful. For example, many thousands of chemicals that occur in foods are foreign for humans and, in the quantities consumed, are not harmful. Cellulose is an obvious example.

BIOLOGY: A RELATIVE SCIENCE

FINALLY, A MISCONCEPTION ABOUT CHEMICALS HAS TO DO WITH the contradictory information about their environmental and human health effects. Contradiction is inevitable; its basis can be found in the uncertain nature of the sciences that deal with human and environmental health. Unlike physics and mathematics, the health sciences cannot provide us with absolute or, in some instances, even reasonably certain answers. Sciences such as mathematics and physics might be called quantitative sciences, absolute sciences, or direct sciences. They deal with phenomena that can be observed and measured directly. The biological sciences are more appropriately termed qualitative sciences, relative sciences, or indirect sciences. They deal with phenomena that cannot be observed directly, but must be measured or described by some effect they produce. The latter allows for interpretation.

People do not question the law of physics that tells them a ripe apple will fall to the ground rather than fly skyward. People do not question the principle of mathematics that says a whole pie is equal to all the pieces cut from it. But people do question toxicological precepts such as that every chemical, with a few rare exceptions, has some level of exposure below which no adverse health effects will occur.

If a chemical has no toxic effect, there is no experiment that can prove that. Experiments showing *lack* of toxic effect can always be challenged with arguments that the number of animals was insufficient, or too few generations were exposed, or the species used was inappropriate. There is an endless supply of challenges. The problem is that *it is not possible to prove a negative.*

Many of the questions asked about the effects of environmental chemicals are stated in the language of science, but are unanswerable by science because science cannot conduct the experiments necessary. Dr. Alvin M. Weinberg coined the term "trans-scientific" for such questions: they transcend science.

Trans-scientific questions uppermost in the minds of individuals relate to whether or not exposure to trace amounts of some chemical will be harmful to personal health. Toxicologists can answer all questions about what quantities of exposure would be harmful, but they cannot answer many questions about what quantities of exposure would be absolutely harmless. There is no way of knowing the exact biochemical makeup of any individual, or exactly what quantity of chemical would be just below his sensitivity to its most subtle adverse effect.

Trans-scientific questions uppermost in the minds of legislators and regulatory officials relate to the nature and incidence of adverse effects that might result from exposure of large populations to trace quantities of environmental contaminants. Science does not have the resources — money, trained personnel, laboratory facilities, experimental animals — to provide such information for even a few, much less all, of the many chemicals we encounter in daily life. Toxicologic judgment based on a wealth of available information about the toxicity of chemicals in general, and specific chemicals in particular, can provide practical, workable answers.

PRACTICAL ANSWERS Of course, the scientific papers describing toxicity experiments are not themselves the practical, workable answers. Rather, they supply the basic information used in making judgments. Our whole system of tolerances for pesticide residues and food additives (instituted many decades ago by USDA and FDA, and continued to the present day by EPA and FDA), acceptable daily intakes (ADIs) for all sorts of environmental chemicals (established by the World Health Organization), threshold limit values (TLVs) for all chemicals encountered in the workplace (set by ACGIH, NIOSH, and OSHA) are practical, workable answers to the problems of how to protect people against adverse effects of exposures to all sorts of chemicals by all routes of exposure.

There is no absolute proof that these standards are totally protective for all people. (Again, there can be none because such questions fall into the trans-scientific realm.) Toxicologists are fully aware of the deficiency in such standards, but consider that they are protective for the great majority of people because they are set using large margins of safety.

The fact that standards for chemical exposures have worked well in protecting individual and public health is demonstrated by the fact that, in countries where they are enforced, people in general live longer and healthier lives. Many environmentalists disagree with that contention, but vital statistics, such as morbidity and mortality rates and life expectancy, demonstrate its validity.

NEWS-MEDIA TOXICOLOGY

WHAT DOES IT MATTER THAT MANY PEOPLE HAVE MISCONCEPtions about the toxicity of chemicals? I've been asked by the editor of this magazine to comment, as a scientist, on the dangers of what I have called "news-media toxicology" — an unreasoning chemo-phobia, based on sensationalized or out-of-context or unscientific reporting of chemical hazards, that so often interferes with reasonable debate and action.

Misconceptions create public hysteria, which forces precipitous and costly actions. Such actions, taken by regulatory bodies in well-meaning response to citizen pressure, may allay the hysteria. But if they produce no fundamental change or real public-health benefit, they are merely cosmetic.

Some such actions have actually done more harm than good, and all have wasted valuable resources (money, debate, etc.) that could have been put to better use. For example, I have definite opinions on the costly (and, I believe, detrimental) asbestos-removal program in schools. Little or no publicity is given to the fact that airborne concentrations in schools are often many times higher *after* asbestos removal than before. Yet I hesitate to use specific examples in a magazine, because they really should be accompanied by scientific references, to avoid charges of political motivation.

Let's look at a relatively uncontroversial example. Several years ago, hysteria created by the fear that pesticide residues on produce might cause cancer prompted some supermarket chains to institute private residue-testing programs. But, of course, the rapid screening methods necessarily used for such programs (because produce is perishable) cannot detect all pesticides in all quantities. Thus, a pesticide-free label means only that specific pesticides are not present in quantities greater than those that can be detected by the quick method. Smaller quantities of the targeted pesticides, and any quantity of other pesticides, may be present. A pesticide-free label, in other words, does not necessarily mean pesticide-free. At best, we consumers indirectly paid for the program, and we did not get what we were made to think we were getting. At worst, it shows a condescending, "band-aid" approach to public concerns: cosmetic reassurance takes the place of scientific explanation.

There were *no reports of any produce being rejected* as a result of the private testing programs, a fact that didn't surprise pesticide regulatory officials. Monitoring by government regulatory agencies already shows that most food samples contain little or no residues. Food samples that do exceed tolerances (quantities scientifically determined to be safe) are rare, and almost always the result of a localized misuse of pesticides. Environmental organizations claim that monitoring of foods by regulatory agencies is inadequate to protect public health. But there is no way to determine with absolute certainty that no food contains residues in excess of tolerances, other than to analyze *all* food — a ridiculous situation that would leave no food available for consumption.

WHAT CAN YOU DO ABOUT THE OBSTACLES PRESENTED BY THE misconceptions I've discussed, and others? There may be a clue in a bumper sticker I often see here in California: "Question Authority." In this case, who are the authorities providing us with information about environmental problems? Almost exclusively, they are organizations dedicated to environmental protection.

The public interest engendered by the environmental movement has been a positive contribution — critical, in fact. However, we must keep in mind that, although the "movement" had its origins in altruism, environmental organizations have become businesses dependent on public interest and financial support for their continued existence and for the livelihoods of their staffs. Thus, they could be seen to have as great an interest in fostering public fears of environmental chemicals as chemical industries have in assuring the public that there is no cause for alarm.

Furthermore, a desire to protect the environment, no matter how sincere, does not automatically confer the wisdom needed to formulate effective policies. Environmentalists have no more knowledge about how best to protect the environment than do environmental scientists affiliated with universities, or government, or even industry. No one group has a monopoly on sages.

Most people associate lobbyists with industry, and think that they promote policies that may be detrimental to the public good. The few people who recognize that lobbyists also work for environmental organizations usually believe that these lobbyists promote only policies beneficial to the public good. A more realistic view is that industry lobbyists work for the good of industry, and environmental lobbyists work for the good of environmental organizations. That's the way politics (and human nature) works.

We must recognize that public policies are derived ultimately from us, the public, our needs and demands, as long as we make ourselves heard. But the public must have good information. So, after questioning authority, we have to become informed. Investigating all sides of issues means not falling for those that fit our current biases. An informed person is not at the mercy of propagandists — on either side.

nvironmental organizations, dependent on public support, have as great an interest in fostering public fears of chemicals as chemical industries have in assuring the public that there is no cause for alarm. A realistic view is that industry lobbyists work for the good of industry, and environmental lobbyists work for the good of environmental organizations.

Compost *A report on how to get your pile of kitchen and yard wastes out of the sick bed, and back to producing rich, loamy compost.*

BY ROBERT KOURIK

ILLUSTRATION BY ALAN E. COBER

BECAUSE I'M SOMETIMES RECOGNIZED AS "THAT GARBAGE guy," more than a few folks have asked me to take a look at their backyard compost piles. They think their ailing piles are in need of a little Rx. Seems plenty of folks are composting kitchen and yard waste, but they don't get that brown, rich stuff seen spilling out of bins pictured in glossy magazine ads. Don't blame the pile. Often, a novice expects too much from a random batch of organic discards. Any heap of dead plants will rot ... eventually. But only a rapidly composting pile, also called hot or active composting, will *quickly* reduce organic waste and possibly conserve a few nutrients.

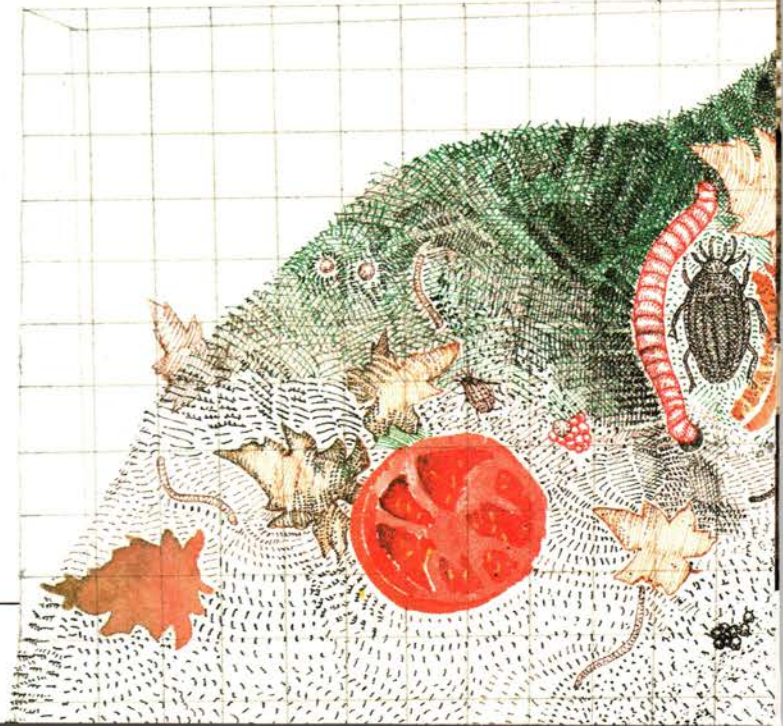
A healthy compost pile produces a valuable amendment that improves the soil's capacity to drain, hold moisture, retain certain nutrients, and remain loose and friable. Composting is a dynamic process — sometimes slow, sometimes fast. Though we may have great expectations, even "fast" composting won't occur overnight.

With active or fast composting, the gardener carefully builds a pile of kitchen and yard waste and regularly turns it, producing a hot interior temperature and a finished material that's a good soil amendment (and a very weak fertilizer). Active compost piles can *sustain* temperatures of 140 degrees F. or more — thus the designation "hot composting." Depending on the type of ingredients you put into the pile and the number of times you turn it, the fast track generally takes two to six weeks to transform yard and kitchen waste into compost.

Slow piles are also known as "passive" composting (because the gardener doesn't have to do much) or "cool" composting. The reason? When the pile is first thrown together, its internal temperature can hit 160 to 180 degrees F. — stoked by heat-generating bacteria feasting on organic matter. As the bacteria are killed by high temperatures, the pile quickly cools. But composting continues (at a slower pace) thanks to bacteria, microbes, and fungi which take over when the pile's internal temperature approximates cooler outside air temperatures.

To be a good compost doctor, you'll need to understand how a pile transforms bulky garden wastes into a material resembling the dark, loamy layer of a forest's floor (look under the leaf layer). Composting is not the same as rotting, decomposing, decaying, or moldering. But it does embrace a bit of all of these processes. Here are a few crucial definitions and their relationship to active and passive (hot and cold) composting:

■ **Decay** - Usually, this refers to a cool process, where internal temperatures roughly equal outside air temperatures. When a pile decays, it loses some nutrients (nitrogen). This slow pro-



cess allows nitrogen to be vented as gassy ammonia (volatilized) or washed away (leached) by rain (especially when the pile is uncovered). The end product may have fewer nutrients than compost from a hot pile, and proportionately more minerals.

■ **Decompose** - All forms of composting decompose the Irish stew of raw garden wastes into basic nutrients such as nitrogen, phosphorus, and potash. Humus, an important end product, is in some ways a more complex substance than the ingredients that go into the bin. Humus is *produced* by the microbial digestion of organic matter. It's *composed* of starch-like molecules that possess a tremendous capacity for retaining moisture and slowly releasing nutrients to a plant's root hairs. A soil's humus content is, in great part, a measure of its fertility, friability, and drought resistance. Passive composting eventually produces some humus. Active composting quickly produces more.

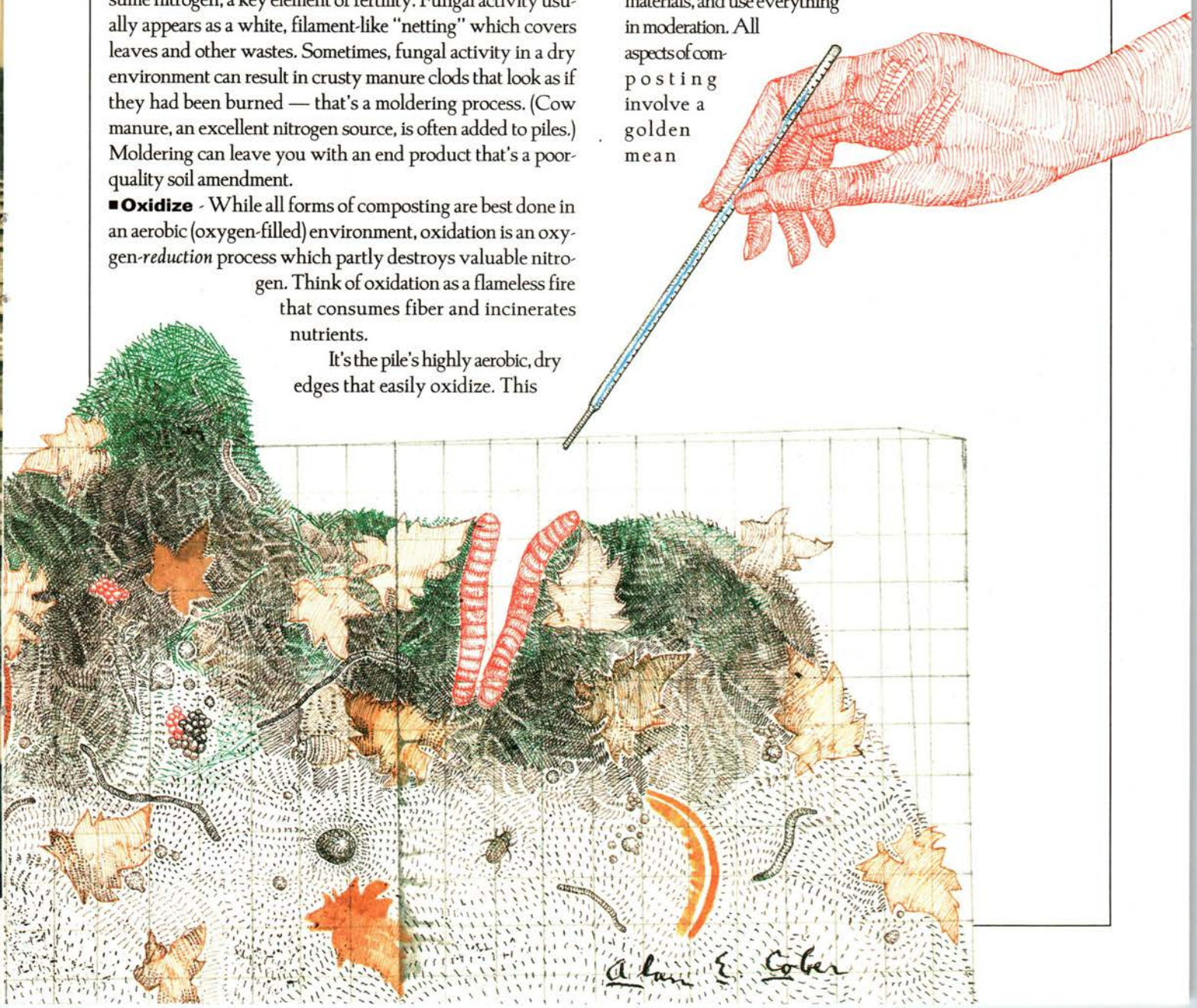
■ **Molder** - While bacteria often get the credit for devouring a pile's organic ingredients, fungi also play an important role in decomposition, particularly of manure. Caution: Fungi consume nitrogen, a key element of fertility. Fungal activity usually appears as a white, filament-like "netting" which covers leaves and other wastes. Sometimes, fungal activity in a dry environment can result in crusty manure clods that look as if they had been burned — that's a moldering process. (Cow manure, an excellent nitrogen source, is often added to piles.) Moldering can leave you with an end product that's a poor-quality soil amendment.

■ **Oxidize** - While all forms of composting are best done in an aerobic (oxygen-filled) environment, oxidation is an oxygen-*reduction* process which partly destroys valuable nitrogen. Think of oxidation as a flameless fire that consumes fiber and incinerates nutrients.

It's the pile's highly aerobic, dry edges that easily oxidize. This reduces the amount of organic matter and humus and volatilizes the ammonia (nitrogen), leaving you with more minerals (mostly ash). While minerals are important soil nutrients, they're the third thing you should try to conserve — after nitrogen and organic matter. (Contrary to popular opinion, "anaerobic" or oxygenless digestion conserves the greatest amount of nitrogen and is a slow, heat-consuming process. Unfortunately, the resulting stench can be overwhelming.)

■ **Rot** - The key difference between composting and rotting is time. Just about everything rots. If you have plenty of space to store bulky garden wastes, then a cool, passive pile (or set of piles) may be your most practical form of composting. Even though a rotting pile will produce a finished material with fewer nutrients, it involves much less work.

An active compost pile is a three-legged chair, dependent on the proper nitrogen content, moisture, and oxygen. If any one of these ingredients is missing, the chair topples. Two other important composting axioms: Always use a variety of raw materials, and use everything in moderation. All aspects of composting involve a golden mean



— too little of, say, carbon-heavy leaves and woody debris will bring about failure, while too much of the same will also lead to ruin. There is no magic formula. Composting is a craft, best perfected by casual practice.

Nitrogen and Carbon

GARDEN WASTES FALL INTO TWO MAIN CATEGORIES: FRESH GREEN stuff and manure, with generous amounts of nitrogen; and woody things with a high carbon but low nitrogen content. A hot, active pile needs a certain amount of nitrogen to reach a high temperature. The heat comes from jillions of bacteria, microbes, and soil fauna furiously munching on organic matter. The protein for their microscopic bodies comes from nitrogen. Without fresh leafy greens, manure, kitchen scraps, or some other nitrogen source, the micro-critter population can't increase enough to quickly digest the tough, chewy carbon found in woody material.

There are lots of confounding formulas for a good compost mix — such as the infamous advice of a carbon-to-nitrogen ratio of 30:1. Don't worry about these fancy "rules." In the real world, you just mix up a pile with lots of what's available ... and watch. The pile will moderate itself. If there's too much nitrogen, the pile will exhale the surplus nitrogen as a gas (it smells like ammonia). If there's too little nitrogen, the pile will heat just a little and will take longer to fully decompose. So you change the mixing formula for the next batch of ingredients. With time, you'll figure how much of each ingredient to include.

Moisture

IF THE MICROBES ARE GOING TO CHEW ON YOUR WASTES, THEY'LL need plenty of water. This doesn't mean the perfect pile is soggy. With a properly moist pile, you can't wring water out of the organic matter.

In areas like the East Coast and Pacific Northwest, rain may provide all the moisture your compost pile needs. Often, high-carbon materials like straw, chipped limbs, and fallen leaves are pretty dry. If rains haven't already moistened these materials, you'll need to add some water while you're building the pile. Use an automatic shut-off hose sprayer or a fine mister. Once the pile is built, cover it with a tarp to trap moisture.

If you get the pile too wet, the soggy, anaerobic mess will emit a slightly sulfurous odor. If the pile is too dry, the material will be slow to rot and you may get a proliferation of a white, filamentous mass due to fungi. In arid regions with little humidity, insufficient moisture is the most frequent missing "leg" of a stable compost "chair."

Oxygen

THE CRITTERS THAT INHABIT A HOT PILE ARE ENERGETIC, AEROBIC little beasts. And they need plenty of oxygen to do their aerobics.

A healthy compost pile requires generous amounts of kitchen scraps and other green materials.

There are bacteria and microbes that work in airless (anaerobic) environments, but they tend to be slower, smellier, and messier. An anaerobic pile often has a noticeably foul odor and is visibly mucky in the pile's middle. To miss out on this mess, build your pile with a wide variety of ingredients. A pile of nothing but grass clippings will certainly be reduced to muck as it settles. A few wood chips, some straw, a few vegetable clippings, and a bit of leaves all mixed together is more likely to remain aerobic. If not, turning the pile will probably correct the problem.

Remember, too much oxygen can be just as bad as not enough. If the woody material seems fluffy and desiccated, or the carbonaceous material hasn't browned, the pile's sides and top should be covered to cut incoming air.

If you're considering buying an insulated bin for cold weather composting, keep this in mind: Composting is due to an *internal* process. A hot pile's high temperatures come from the heat generated by hard-working, heat-loving (thermophilic) bacteria and microbes. Even with a so-called insulated bin, a compost pile will lose heat to cold winter temperatures. With the help of cold-tolerant (cryophilic) bacteria and fungi, cold piles do decay. They just take their time.

You were born with all the diagnostic tools you need to analyze an ailing compost pile — your eyes to gauge the ingredients' quality, your nose to smell odors, and your hands to sample the relative temperature inside the pile. (A compost thermometer, which looks like a poultry thermometer with a long stem, can help track the heating and cooling process.) A compost pile can turn sour on even the most practiced gardener. The question is, "Will I swallow my pride, admit defeat, and rebuild the unproductive pile?"

Reconstructing a pile that's gone bad allows you to diagnose the problem, consider possible remedies, administer the cure, and see how the patient responds. So in the words of W. C. Fields, "Grab the bull by the tail and face the situation!" The effort will accelerate your learning curve, and you'll be better versed in the craft of composting.

The following chart was compiled by consulting a number of composting experts throughout the country. A sick pile's symptoms are followed by a number of possible causes, each with a corresponding corrective measure.

ROBERT KOURIK

CHARTING A HEALTHY COMPOST PILE

SYMPTOM	POSSIBLE CAUSES	PRESCRIPTION
Rotten or sulfurous odor.	• Too many food scraps; or "lumping" food wastes. • Too wet. • Too many grass clippings in a mass. • Material shredded into particles which are too small. • Anaerobic conditions.	• Eliminate food scraps (put them in a worm bin). Or, mix food wastes evenly throughout the pile. Add coarser material to keep moist food scraps more aerobic. • Turn pile while adding some dry, high-carbon material such as leaves or chipped wood. Will eventually correct itself as the pile drives off excess nitrogen. Cover bin during rainy spells. • Mix grass clippings with coarser and drier, high-carbon material. • Turn pile while adding material of different sizes and coarseness. Layer pile with plenty of loose, bulky material. • Tear pile apart, diagnose problems, and rebuild a loose pile with many types of materials. Sometimes, an anaerobic condition is due to a pile which is too big — the weight of the upper portion compresses the lower layers. Make piles smaller.
Ammonia smell, mostly when turning pile.	• Too many grass clippings in one mass, or layered too thickly. • Too much manure; too many kitchen scraps. • Anaerobic.	• All symptoms of too much nitrogen. If the pile is left alone it sometimes self-corrects by volatilizing nitrogen. Leave alone. Or, turn the pile while tearing apart any matted lumps of high-nitrogen material (adding coarser, high-carbon compostables) and rebuild into loose, aerobic layers. • Often due to one of the following: material is the same size; material is overly shredded (bits are too small); pile is too large; pile is overly moist. Either leave alone until the smell ceases; or rebuild using the guidelines mentioned for 2A/2B.
Pile has low temperature.	• Pile has finished composting. Not a problem, time to use the material. • Pile too small. • Too much high-carbon material. • Too dry or too wet. • Material too coarse or too fine. • Not enough nitrogen.	• Congratulations, you're now a certified Captain of Compost. • The classic formula for hot compost recommends a pile built with at least 27 cubic feet (3' X 3' X 3' — a cubic yard) of material. Save up raw materials until you have enough to build a pile of one cubic yard. • Rebuild pile, adding nitrogen — manure, grass clippings, kitchen scraps, or fresh garden wastes. • If too moist, you'll smell something awful. Rebuild and add dry, carbonaceous material. Cover when raining. A dry pile has no odor — rebuild pile while misting the raw material. In arid regions, a cover may help contain moisture. • Overly coarse material can make a dry pile; overly fine can make an anaerobic pile. Use many different-sized materials. Rebuild pile with a heterogeneous mix.

A compost thermometer helps track a pile's heating and cooling process.

Turning the pile helps circulate oxygen.

SYMPTOM	POSSIBLE CAUSES	PRESCRIPTION
Pile too hot.	• Temperatures above 160 degrees F. can kill beneficial microbes. Temperatures above 180 degrees F. will sterilize the pile's core. • Pile too big. • Too much nitrogen.	• The hot pile will kill off a lot of the bacteria and the temperature will drop, then a few remaining microbes will re-inoculate the pile. Turning the pile will help cool it. • Break the large pile into smaller piles of one cubic yard or less. • Turn pile while incorporating more carbonaceous material.
Pile bursts into flames.	• Pile way too big. • Enormous pile is too dry.	• The pile must be very large. It rarely bursts into flames, but can smolder. • Don't build big piles. While lots of nitrogen is needed to generate heat, the pile's upper layers must be very dry to combust.
White moldy/fungal growth.	• Not really an illness; most likely the filament of beneficial fungi as they help digest compostables. While there are fungi which thrive at all temperature levels, fungal growth is usually noticed when the pile is in a mesophyllic condition (cooler than hot compost, but not a cold process). • Too wet or too dry.	• If you want a thermophilic pile, adjust the carbon-to-nitrogen ratio, check the moisture level, and turn the pile. • A dry condition often favors fungi. Either way, adjust moisture by rebuilding the pile while either adding moist or dry material (depending on the condition).
Nothing rots.	• Not enough moisture. • Material too woody or not enough nitrogen. • Not enough available carbon. • Pile too small.	• Rebuild the pile while misting material. • Shred any woody material which is too chunky; or mix in more nitrogen-filled material (such as fresh lawn clippings). • Shredding "waxy," hard leaves helps aerobic microbes. • Save up raw materials until you can build a pile measuring 12 to 27 cubic feet.
Flies and insects in and around pile.	• Too much food waste.	• Reserve the kitchen scraps for your worm bin, or add them only to the pile's middle. If this doesn't solve the problem, stop mixing vegetable wastes with fruits and edible parts.
Mice and rats in pile.	• Food wastes.	• First try adding the kitchen scraps to the middle of a hot pile. If that doesn't work, try eliminating all meat, dairy and fish scraps and all salad and cooking oils. Or, eliminate all kitchen wastes and use them in a worm bin. Some bins are sold with tight fitting, plastic bottoms and lids to help exclude rodents.

Old wooden pallets are a good material for building bins.

Sources: Howard Stenn, Master Composter Program, Seattle; Dr. Robert Raabe, University of California at Berkeley; Gary Brinen and Joy Stinson, Alachua County Cooperative Extension Service, Gainsville, Fla.; Paul Conrad, The Gardener's Supply Catalog, Burlington, Vt.; Chip Tynan, the Missouri Botanical Garden, St. Louis.

GREEN LIGHTS for Home & Business

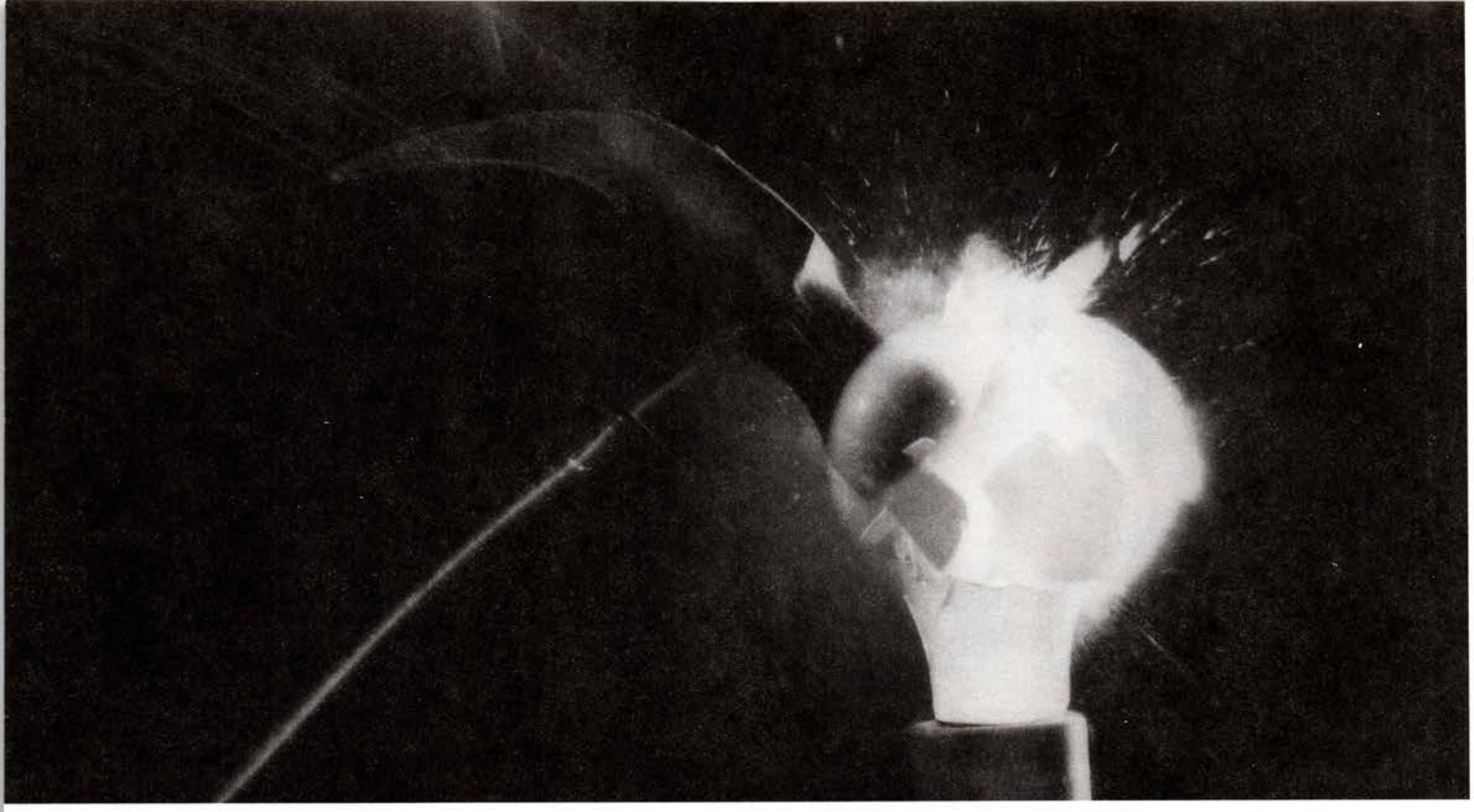
STORY BY
Jim Tracy

ILLUSTRATIONS BY
Seth Jaben

COMPACT-FLUORESCENT LIGHT BULBS EPITOMIZE OUR STRUGGLE TO green our lifestyles: We know they're wonderful energy-savers. But these white tubes of glass, folded into clean, geometric shapes, are just strange enough that we resist inviting them inside. Resist no more. Energy savings from compact fluorescents translate into a smaller tab for household electric use, and lower pollution levels from fossil-fuel powered generating plants. Here's how....

In the late 1970s, four scientists from the Dutch company Philips, N.V., after numerous false starts, devised a light that relies on mercury and phosphors (a generic name for substances that phosphor, or give off light) trapped together in a sealed glass tube. Their invention, a squat version of the fluorescent tube that has bleached the faces of office workers for half a century, was dubbed the "low pressure mercury vapor discharge lamp." Thankfully, this handle has been shortened to the still ungainly "compact-fluorescent lamp." It casts a warm light you'd be pleased to see yourself under as you confront the bathroom mirror, first thing in the morning.

JIM TRACY IS A TECHNICAL WRITER FOR THE NATIONAL APPROPRIATE TECHNOLOGY ASSISTANCE SERVICE, WHICH SPECIALIZES IN RENEWABLE ENERGY AND ENERGY-EFFICIENT LIGHTING.



STRIKE A BLOW FOR THE ENVIRONMENT.

The brightest idea to come along in a long time.

A partnership between the federal government and America's business community to protect the environment by promoting the use of revolutionary lighting technologies that reduce pollution.

Green Lights, a voluntary corporate initiative, encourages the use of energy-efficient lighting where it is profitable and where lighting quality is improved. Through this initiative, over 150 major corporations have already agreed to reduce emissions of greenhouse gases and help curb acid rain and smog by voluntarily upgrading their lighting systems.

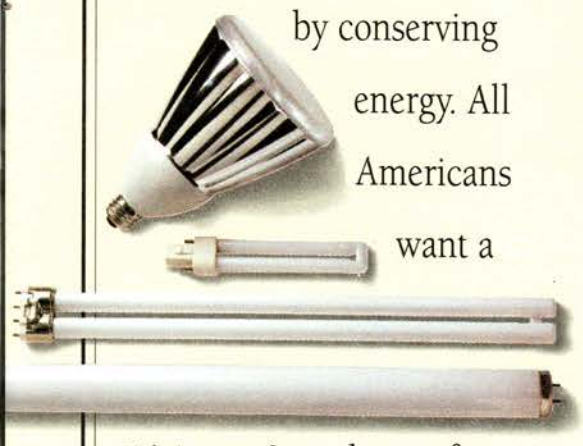
To learn more about the environmental benefits of energy-efficient lighting and how you and your company can profit from it, call (202) 775-6650. Or write, Green Lights, U.S. Environmental Protection Agency, Global Change Division, 401 M Street, SW. (ANR-445), Washington DC 20460.

Set a shining example.

GREEN LIGHTS
Environmental Protection Agency

You Can Do Something For The Environment Every Time You Turn On The Right Light.

Today's compact fluorescent bulbs consume one-fourth the energy of incandescents and can last up to 10 times longer. By switching to these bulbs, we could lower electric bills and help our environment by conserving energy. All Americans want a clean, safe environment. And, as America's electric utilities, we're doing something about it. We're developing new electric technologies that enable each household to make decisions that benefit our environment.



Today's compact fluorescent bulbs consume one-fourth the energy of incandescents.

For example, cooking in a microwave oven can save 90% of the energy used by a standard gas oven and release less emissions. And that figure even takes into consideration emissions that are expended at the source. Today's refrigerators can require 80% to 90% less energy than models built just ten years ago.

America's electric utilities will continue to help refine and perfect such technologies. Equally important, we will continue to encourage you to join us in our quest for a cleaner environment.

Replacing a 75 watt bulb with an 18 watt compact fluorescent lamp can provide light up to 10 times longer.

For more information, call the Edison Electric Institute at 1-800-438-8334 or, in Washington, call (202) 508-5002.

ELECTRICITY
Taking you into the future.

The inventors understood immediately the importance of their discovery. "As the efficiency of the low pressure mercury vapor discharge lamp is five times greater than that of the incandescent lamp, a very considerable savings in energy is possible," they wrote in patent papers filed in the U.S. in February 1980.

Edison's incandescent bulb, now 110 years old, has been upstaged. The compact fluorescent screws into a standard socket and has an efficient ballast (a tiny transformer that feeds the bulb electricity), so it uses one-quarter to one-third of the electricity of an incandescent, and lasts 10 to 13 times as long — totaling (by conservative estimates) 1.1 years of continual use.

WHEN COMPACTS 'FLUORESCE'

WHAT GOES ON IN THOSE MAGICAL TUBES? CRUDE BY COMparison, Edison's bulb uses electric current to heat a coiled metal filament until it glows white hot. The same thing happens in a toaster, although those coils don't reach white-hot temperatures. While lighting your home with incandescents is an improvement over lighting with toasters, it is still grossly inefficient. Ninety percent of the electrical energy put into an incandescent produces heat, and only 10 percent produces useful light.

The fluorescent is miserly in comparison — and more complicated. The modern version consists of an airtight glass tube, coated on the inside with powdered phosphors, and filled with a mixture of mercury droplets and highly purified gas, usually argon.

The 16-watt fluorescent saves roughly $33 a year over its lighting equivalent, the 60-watt incandescent

A cap fitted with an electrode covers each end of the tube. Rather than emit light, these electrodes shoot electrons into the bulb as electricity flows through them. Like lightning in a bottle, this stream of electrons quickly vaporizes the mercury droplets with the help of the argon catalyst. Now an ionized gas, the mercury emits ultraviolet radiation. When showered by this invisible radiation, the phosphors glow, or fluoresce.

Finding the right combination of phosphors and so-called phosphor activators that would work in a short, narrow tube had vexed Philips scientists and their competitors for decades. Phosphors that thrived in longer lamps quickly lost their light output in shrunken tubes. When bombarded with great numbers of mercury atoms and ions, they toasted, leaving dark patches on the tube wall.

The Dutch scientists blended and reblended phosphors. The compounds, described in their patent papers, read like a madcap version of the periodic table of elements: bivalent europium-activated strontium tetraborate; lead-activated barium disilicate; bivalent europium-activated strontium chlorophosphate with apatite ... you get the idea.

Suffice it to say that among these ingredients, they discovered a mixture that is stable and emits light across the spectrum from red to blue and violet. Their lamp converts most of its electricity into light — warm light that lets the true colors of faces and apples and daffodils shine through.

SAVINGS FROM COMPACTS

COMPACTS ARRIVED ON AMERICAN SHORES IN 1980, BUT FEW people outside of the lighting industry knew much about them. Even lighting engineers looked upon them as a curio. Compost sales slugged along at first. By 1982, sales reached 200,000 in the U.S. — a fraction of a fraction of the 1.4 billion bulbs we buy in a year. By 1986, sales climbed to 3 million. In 1989, compacts snared 2 percent of the total lighting market in the U.S. (as compared to 9 percent in Europe and 5.8 percent in Japan).

Arthur Rosenfeld, a physics professor at Lawrence Berkeley Laboratory, estimates that 50 million compacts are now lighting offices and homes in the U.S., saving electric ratepayers $1.4 billion. He has translated these savings into coal, kilowatt hours, and gallons of gas.

He starts by replacing a 60-watt incandescent with a 16-watt fluorescent (they yield about the same light). This saves 44 watts per hour at the meter. Assuming (conservatively) that the 16-watt fluorescent has a lifetime of 10,000 hours, over that lifetime it will save 440 kilowatt-hours (kwh) at the meter (10,000 hours X 44 watts).

That 440 kwh, Dr. Rosenfeld calculates, is equivalent to the energy from burning 450 pounds of coal or 39 gallons of gasoline. In the average car, that represents 39 days of typical driving. "In other words," Dr. Rosenfeld says, "the amount of energy saved by 10 compact fluorescent lamps burning continuously in the stairwell of a hotel, for instance, is enough to run a new car for 10,000 miles a year." That 440 kwh also represents a sizable cloud of pollutants that cause smog and acid rain, and contributes to the greenhouse effect.

But why stop at 10 bulbs? Incandescent lamps in the U.S. use about 200 billion kwh a year, or eight percent of all U.S. electricity. Assume that eventually half of the energy used today by incandescents — that's half of 200 billion kwh, or four percent of our electricity — would be saved by the switch to fluorescents. Dr. Rosenfeld says that translates to savings of $7.5 billion a year in electric bills, or four percent of all the coal mined in the U.S., or the capacity of 19 (1,000 megawatt) power plants.

Utilities have made compact bulbs big business. With brownouts occurring in some parts of the country, and forecasts of more power shortages, utilities have hit on the notion of "negawatts." It turns out, given the astronomical cost of building a new power plant, a kilowatt saved (a negawatt) is a kilo-


V
10,000 HOURS
III
IV
II
I
VI
Fig 4

watt earned. So utilities are making compact fluorescents a part of their negawatt strategy.

Osage Municipal Utilities, which serves a small Iowa town, has given away hundreds of lamps since 1988, and now offers a $7.50 rebate to customers who buy them at local stores. Wes Birdsall, the 63-year-old manager of the utility, has become something of a negawatt missionary. He started Osage's heralded conservation program when he joined the utility in 1972, and has carried the Osage message to seminars, workshops, and conventions across the country. He even convinced his fellow congregation members at Our Savior Lutheran Church to switch. "Heresy!" cried the traditionalists who didn't like the looks of the odd, new lamps. "But the pastor is very happy with them," says Mr. Birdsall.

If he's the guy who pays the bills, he should be happy. Returning to Rosenfeld's arithmetic, if electricity costs 7.5¢ a kwh, each 16-watt fluorescent saves $33 a year over the 60-watt incandescent (440 kilowatt-hours X 7.5¢ per kwh). The bulbs last longer if they're on intermittently, but a conservative lifetime would be 10,000 hours.

THE GREEN LIGHTS PROGRAM *Greenbacks for Businesses Who Lighten Up*

THIS MONTH'S LIGHT BILL AT American Express's 388 Greenwich Street office in Manhattan is 18 percent less than it used to be, thanks to the federal government.

Wait a second. What did Amex do, take a Congressmuffin to lunch? No, the only weight Amex threw around was the fat old fluorescent tubes that were eating too much energy.

But since when is the federal government in the business of saving other people's money? Since the inception of the federal Environmental Protection Agency's Green Lights program in January, 1991. The program's goal is to prevent pollution by encouraging major institutions — businesses, governments, schools — to use energy efficient lighting.

Amex is a charter partner. Like the 200 other corporations, four cities, 11 states, and four counties that are partners now, Amex signed a non-binding Memorandum of Understanding to cinch its participation — it could bail out at any time. But why should it? Here's the commonsense list of Green Lights' requirements, along with the services EPA offers to help meet them:

- *Survey your U.S. facilities, including any property you'll be leasing for at least five years.* EPA gives you Decision Support Software, a computer program that spits out survey forms, among other things. These you fill in as you tally up your current fixtures, bulbs, ballasts, illumination rates, labor costs — even taxes.
- *Consider all the efficient lighting options.* EPA has a database of bulbs and ballasts, listed by brand name and characteristics.
- *Within five years, retrofit 90 percent of the area with efficient lighting as long as it's profitable to do so, and the light quality doesn't suffer.* The computer spits out a room-by-room analysis of which options would be cheapest and most suitable. It prints copies tailored to each department that might need information.
- *Document progress with the installation, as well as energy savings and related pollution prevention.* EPA, of course, provides all of the forms.
- *Design new buildings to incorporate high-efficiency lighting.*

For Amex, a large part of the solution was very simple: Phase out or change 32,000 inefficient T-12 bulbs (bulbs 12/8" in diameter) and 17,320 obsolete ballasts, the small transformers that feed as many as four bulbs. (Bulbs are normally changed before they burn out anyway, as the light dims seriously before it dies.) Replace them with state-of-the-art T-8 bulbs and efficient electronic ballasts. Install 150 motion sensors that turn off lights when no one's in the room. Now Amex sits back and collects the savings — the average light-bill decrease in the program is 20 to 30 percent. And that's not counting the rich bounties that power utilities pay for "negawatts" (decreased demand) these days — $475,000 for Amex.

What does EPA get out of this? Well, lighting uses 20 to 25 percent of the nation's electricity, and industry uses 80 to 90 percent of that total. When EPA weans industry, it harvests negawatts, a lessened demand for energy, which causes a ripple effect: fewer power plants to find a backyard for; decreased fuel consumption; and, as of April, with new partners signing on every day, a projected 95-million-pound reduction in CO_2 emissions per year. The bonus: an enlightened business community. Says Martin Warfel, vice president of headquarters services, "The one thing [EPA] makes you realize is that when you have a light burning, you have fossil fuels burning somewhere."

Perhaps one oversight of the Green Lights program is disposal of the replaced (and indeed, all) bulbs. A four-foot tube contains some 30 to 50 milligrams of mercury. Dump a few thousand bulbs at once, and your landfill or incinerator is going to have a troublesome, toxic mouthful. In the absence of federal guidelines, it's the states which are pushing for the bulbs to be recycled — Minnesota and California have policies in place. For a list of lamp recyclers, send $5 to Dana Duxbury & Associates, 16 Haverhill St., Andover, MA 01810; (508) 470-3044.

For information on joining the Green Lights program, contact the U.S. Environmental Protection Agency, Green Lights Program, Global Change Division (6202J), 401 M St., SW, Washington, DC 20460; (202) 775-6650.

— *Hannah Holmes*

DIM HOPE FOR INCANDESCENTS

NEXT TIME YOU BURN YOUR FINGERS ON A LIGHT bulb, remember this: The stupid thing is so hot because incandescent light bulbs give off 90 percent of the electricity they consume as heat, rather than light.

It's tough to coax any real efficiency out of incandescents, but if you do choose to use them, compare packages for the optimum lumens-per-watt ratio. (Lumens are a measurement of a light source's total light output in all directions.) Efficiency increases with wattage. For example, a standard 100-watt bulb puts out 1,750 lumens, roughly equivalent to the 1,780 lumens you'd get from two 60-watt bulbs, but burning 20 percent less electricity.

Clocking in at about 750 hours, incandescents have the shortest life span of all available lamps. There are some "long-life" bulbs around that can last from 1,500 to 3,000 hours (compact fluorescents last for at least 10,000 hours). These bulbs last longer because they have larger-diameter filaments which don't get as hot and thus take longer to fry. While they may give you a ten-percent energy savings, they also put out about ten percent less light.

Don't be lured by the gadgets at hardware stores that extend incandescent life. One type, called thermistors, extends bulb life by three times, but reduces light output and efficiency by ten percent. Another life-extender is a penny-sized diode that fits into a standard light socket. It extends bulb life by about 50 times, but reduces the light output of the bulb by 75 percent and reduces efficiency by 50 times.

Increasingly popular halogen (incandescent) bulbs are two or three times more efficient than regular incandescents, last three or four times longer, and give an exceptionally bright light. And they're not done evolving. GE has a new halogen bulb, not yet widely available, which is coated with infrared reflecting material. The coating keeps the heat in, where it can help heat the filament, giving the bulb a 26 lumens/watt ratio, as opposed to the standard 17.5 lumens/watt of an incandescent.

Halogens are not without drawbacks. Because they burn at higher temperatures than regular bulbs, and use quartz in place of regular glass, halogen lamps emit more ultraviolet radiation than standard bulbs. Over time this can fade paint and damage some textiles. The good news: The UV is easily blocked with a plastic or glass cover that comes with many halogen lamps. Leave the covers on.

— Ethan Seidman

The simple payback time, then, for a continuously-burning 16-watt fluorescent that retails for $9 and saves $33 a year is 2.3 months — that's including the money you'd save on incandescents. If you pay $20, you get a payback in five months.

RESISTING COMPACTS

SO WHY DO WE RESIST THEM? MANY CONSUMERS DISCOVER THAT fixtures and lamp shades haven't caught up with the shape of compact fluorescents, and that dimmers can't be used with them. Others complain that no fluorescent can match the quality of light from a 150-watt incandescent.

Another major objection is the radioactive isotopes — krypton-85, promethium-147, and tritium — used in some lamps to jump-start them when they are first turned on. These radionuclides in the "glow switch" provide initial ionization of the mercury, especially at low temperatures. Forget glow-in-the-dark fears: only minute amounts (billionths of a curie) are used in the starters, and not all starters use them. Bulbs with an electromagnetic ballast (also called core-coil ballast) do, and manufacturers are required to note it on their boxes. On the bright side, these ballasts can be modular, meaning that when the lamp dies, you don't need to replace the ballast, which can last 45,000 hours. Lamps with an electronic ballast are nuke-free — they're also more efficient, they don't hum or flicker, and they run cooler, which means they last longer and reduce air-conditioning costs. They are not modular.

Replacing a 60-watt incandescent with a 16-watt fluorescent earns energy savings equal to burning 450 lbs. of coal.

It is probably the high upfront cost that spooks most consumers. When you're accustomed to getting two incandescents for a buck, paying $6 to $30 for a fluorescent takes some getting used to — despite the long-term savings over incandescents, plus the savings on your energy bill.

Robert Sardinsky, president of Rising Sun Enterprises and a research associate at Rocky Mountain Institute, admits, "The compact fluorescent isn't a cure-all. What's significant here is that it's a relatively new technology that has widespread application."

Even if Edison's pear-shaped incandescent doesn't go the way of the vinyl record, the compact fluorescent surely will replace it in many, many sockets. It's just a matter of time—and energy.

For more information on NATAS or on energy-efficient lighting, write to P.O. Box 2525, Butte, MT; or call (800) 428-2525.

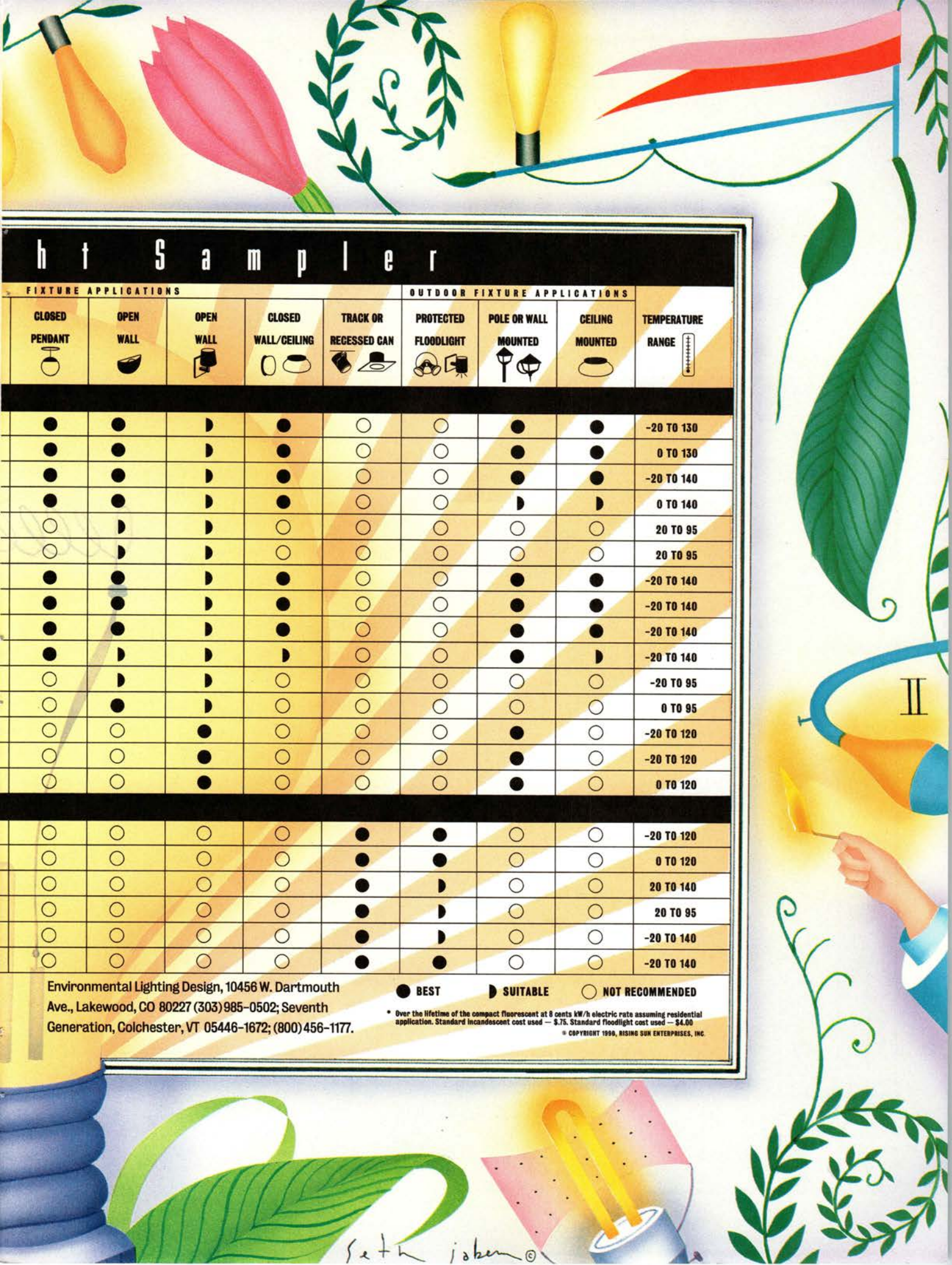
• • •

As much as we hear about fluorescent lights, it's still rare to find a dozen different models on the hardware-store shelf. Thus, it's hard to know which lamps might work in our homes. Use the chart on the following pages to decide which bulbs will work best for you.

A Green Lig

COMPACT FLUORESCENT LIGHTING PRODUCTS	TOTAL POWER CONSUMPTION (LAMP & BALLAST)	APPROXIMATE INCANDESCENT EQUIVALENT	SAVINGS: AVOIDED UTILITY & LAMP COSTS*	SAVINGS: AVOIDED CO_2 EMMISIONS	INDOOR: TABLE/FLOOR LAMP	INDOOR: BARE BULB SOCKET	INDOOR: OPEN PENDANT
STANDARD							
COMPACT 7-TWIN	10.8 W	40 W	$27	767 LBS	◗	◗	◗
COMPACT 9-TWIN	12.9 W	40+ W	$25	712 LBS	◗	◗	◗
COMPACT 9-QUAD	10.5 W	40+ W	$27	725 LBS	●	◗	◗
COMPACT 13-QUAD	15.3 W	40 W	$42	1,174 LBS	●	◗	◗
15 WATT CAPSULE	15 W	60 W	$39	1,064 LBS	◗	●	●
15 WATT GLOBE	15 W	60 W	$39	1,064 LBS	○	●	●
DULUX 11 WATT	11 W	40+ W	$27	762 LBS	●	◗	◗
DULUX 15 WATT	15 W	60 W	$42	1,182 LBS	●	◗	◗
DULUX 20 WATT	20 W	75 W	$52	1,445 LBS	◗	◗	◗
EARTHLIGHT	18 W	75 W	$53	1,498 LBS	●	●	●
18 WATT E CAPSULE	18 W	75 W	$49	1,348 LBS	●	●	●
27 WATT E QUAD	27 W	100 W	$60	1,726 LBS	●	◗	◗
CANDLEFLAME	10.8 W	40 W	$27	767 LBS	○	○	○
SUN GLOBE	10.8 W	40 W	$27	767 LBS	○	●	●
HURRICANE	12.9 W	50 W	$36	978 LBS	○	○	○
FLOODLIGHTS							
PAR 38	10.8 W	60 W	$57	1,293 LBS	○	●	○
REFLECT-A-STAR	15.3 W	75 W	$65	1,568 LBS	○	●	○
SUPER NOVA	15 W	100 W	$84	2,333 LBS	○	●	○
GLOBE FLOOD	15 W	50 W	$44	828 LBS	○	●	○
DULUX FLOOD	11 W	60 W	$57	1,287 LBS	○	◗	○
EARTHLIGHT FLOOD	18 W	75 W	$63	1,498 LBS	○	●	○

BULBS AND RELATED HARDWARE: Real Goods, 966 Mazzoni St., Ukiah, CA 95482; (800) 762-7325. Planetary Solutions, PO Box 1049, Boulder, CO 80306-1049; (800) 488-2088. EcoSource, PO Box 1656, Sebastopol, CA 95473; (707) 829-7562; We Care, 77-725 Enfield Lane, Suite 120, Palm Desert, CA 92260; (619) 345-6914;



h t S a m p l e r

FIXTURE APPLICATIONS					OUTDOOR FIXTURE APPLICATIONS			
CLOSED PENDANT	OPEN WALL	OPEN WALL	CLOSED WALL/CEILING	TRACK OR RECESSED CAN	PROTECTED FLOODLIGHT	POLE OR WALL MOUNTED	CEILING MOUNTED	TEMPERATURE RANGE
●	●	◗	●	○	○	●	●	-20 TO 130
●	●	◗	●	○	○	●	●	0 TO 130
●	●	◗	●	○	○	●	●	-20 TO 140
●	●	◗	●	○	○	◗	◗	0 TO 140
○	◗	◗	○	○	○	○	○	20 TO 95
○	◗	◗	○	○	○	○	○	20 TO 95
●	●	◗	●	○	○	●	●	-20 TO 140
●	●	◗	●	○	○	●	●	-20 TO 140
●	●	◗	●	○	○	●	●	-20 TO 140
●	◗	◗	◗	○	○	●	◗	-20 TO 140
○	◗	◗	○	○	○	○	○	-20 TO 95
○	●	◗	○	○	○	○	○	0 TO 95
○	○	●	○	○	○	●	○	-20 TO 120
○	○	●	○	○	○	●	○	-20 TO 120
○	○	●	○	○	○	●	○	0 TO 120
○	○	○	○	●	●	○	○	-20 TO 120
○	○	○	○	●	●	○	○	0 TO 120
○	○	○	○	●	◗	○	○	20 TO 140
○	○	○	○	●	◗	○	○	20 TO 95
○	○	○	○	●	◗	○	○	-20 TO 140
○	○	○	○	●	●	○	○	-20 TO 140

Environmental Lighting Design, 10456 W. Dartmouth Ave., Lakewood, CO 80227 (303) 985-0502; Seventh Generation, Colchester, VT 05446-1672; (800) 456-1177.

● BEST ◗ SUITABLE ○ NOT RECOMMENDED

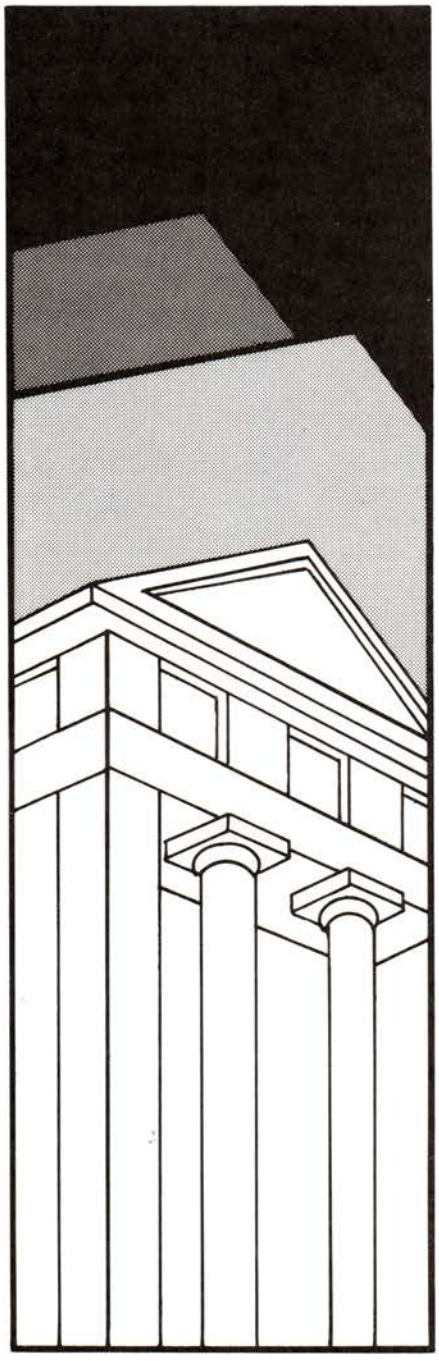
* Over the lifetime of the compact fluorescent at 8 cents kW/h electric rate assuming residential application. Standard incandescent cost used — $.75. Standard floodlight cost used — $4.00

II

Seth Isben ©

Who Says Environmental Protection Makes Economic Sense?

The Parnassus Fund Does!



Parnassus is a mutual fund that invests in companies that are sensitive to the environment. We also invest in companies that practice corporate social responsibility -- firms that, for example, treat their employees well, have good affirmative action policies and are creative and generous with their charitable contributions. At the same time, we avoid investing in companies that manufacture weapons, produce alcohol or tobacco, are involved with nuclear power or have operations in South Africa.

If you're interested in learning more about the Parnassus Fund, call us at (800)999-3505. We'll send you back a free prospectus and other information about the Fund.

THE PARNASSUS FUND
244 CALIFORNIA STREET
SAN FRANCISCO CALIFORNIA 94111

☐ Please send me a free prospectus containing more complete information on the Parnassus Fund including sales charges, management fees and expenses. I will read it carefully before I invest or send money.

☐ Please send IRA information.

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Daytime Phone: _____

Call (800) 999-3505

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GAR-6

KEEPERS

PRODUCTS • ALTERNATIVES • RESOURCES

Green Photo Finisher

You bicycled, you didn't pick the flowers, you didn't feed the animals. But when you got home, where did you send your photographs to be developed? What happened to the garbage from your share of the 660 million rolls of 35 mm film we use each year?

Photo developing is a notoriously toxic undertaking. While photo labs increasingly pay attention to what they dump down the drain, few are as attentive to detail as Enco labs in Old Forge, N.Y. Enco recycles its poisonous silver waste, and uses an RA-4 developing system that eliminates dirty, chlorinated wash water. Plastic canisters that come into Enco go back out with Enco's own film in them. The extras are recycled, as are the steel film cassettes, paper mailers, and chemical bottles. Kodak disposable cameras are stuffed with new film and resold, or recycled. Your photos come back wrapped in waxed paper, in an unbleached envelope. And mine looked great.

Send your film (24 exposures of 35 mm is $7.89 plus 90¢) to Enco Photo Labs, Dept. GM, Box 1151, Old Forge, NY 13420; (800) 659-3190.

Soda Bottle Birdfeeder

Not only is this birdfeed-er a lesson in reuse, but it's also about the cheapest bird feeder you can buy. I confess I had doubts about a soda bottle dangling upside down from my lilac bush. But in the field of beverage-container birdfeeders, the sleek soda bottle has it over the ghostly milk jug and the angular milk-carton. (My birds initially preferred the milk jug, but they're a conservative, New England bunch, prone to debate, and they eventually decided in favor of the soda bottle's big seed tray and convenient perches.)

Assembly is painless: You fill a bottle with seed. You screw the metal gadget onto the bottleneck. There's a handle to hang it by, or a spike to pole-mount it.

Two-perch model (for small-necked bottles): $9.95. Four-percher (three-liter bottles): $10.95. Postage/Order ratio: $3/$10; $4/$25; $5/$50. Walt Nicke Company, P.O. Box 433, Dept. GM, Topsfield, MA 01983; (508) 887-3388.

Tape It Again, Sam

Many producers use video tapes just three times to eliminate the risk of taping something wonderful on cruddy film. Then they chuck 'em. Andy Carpel collects these tapes.

Used tapes that come into Carpel Video are evaluated for damage. Then the tape is cleaned of oxide deposits, the dust is removed, the tape is rewound to the manufacturer's specs, and put through a degausser. The like-new tape is wrapped to keep out dirt.

There's a 90-day guarantee on the tapes; VHS for your home VCR saves you 30 to 40 percent. Carpel estimates that the 230,000 tapes he refurbished last year saved the 86,500 gallons of oil required to make new ones. Carpel Video, 429 East Patrick St., Dept. GM, Frederick, MD 21701; (800) 238-4300 or (301) 694-3500.

CHRISTOPHER HARTING

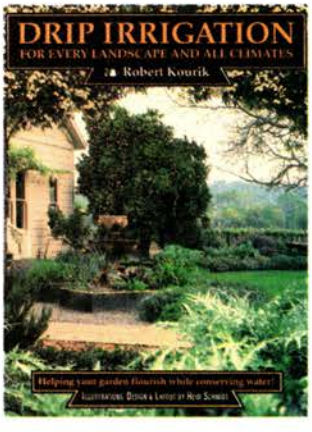
KEEPERS

RESOURCES

Drip Irrigation for Every Landscape and All Climates

BY ROBERT KOURIK. 112 PAGES. DRIP IRRIGATION BOOK, P.O. BOX 1841, SANTA ROSA, CA 95402. SOFTCOVER, $16 PPD.

GARBAGE'S OWN DOCTOR OF Dripology, Robert Kourik, has squashed his considerable knowledge and experience into book form. With his irrepressible humor, Robert introduces not just the why and the what, but also arms you with dozens of drawings and diagrams, including portraits of all the gizmos and gadgets you'll need from the hardware store to build your water-saving, plant-pleasing system. He walks you through the requirements of all sorts of landscapes and plants.



Robert, who installs drip systems professionally, writes, "If this book saves you from the expense and frustration of even 10 percent of what I've gone through, then your money has been well spent. You'll save a fortune in aspirin alone."

The Water Heater Workbook

BY LARRY AND SUZANNE WEINGARTEN. 151 PAGES. ELEMENTAL ENTERPRISES, P.O. BOX 928, MONTEREY, CA 93942. SOFTCOVER, $11.25 PPD; CALIFORNIANS ADD 76¢ TAX.

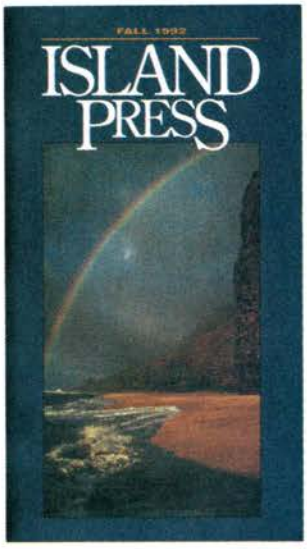
I LOVE BOOKS LIKE THIS — homegrown wisdom straight from the expert, not slicked up by a professional rewriter. Yeah, it's set in an ugly typeface, the illustrations are amateurish, and it's bound in a blue plastic coil. But just read it.

By now, most of us know water heaters are the biggest energy pigs we shelter in our homes. Armed with that insight, many of us have put our pig in a blanket of insulation, to hold in the heat and hold down the utility bill. But, as a new convert, let me inform you that there are many other things — sediment buildup, scaly flue, heat traps, and flue dampers — that can affect the efficiency of a water heater.

The book's tone, like its binding, is unpretentious and pragmatic, and every page is graced with a bit of wisdom. From page 138, try Thomas Carlyle on water heaters: "The foul sluggard's comfort: 'It will last my time.'"

Island Press

YES, I'M LISTING THE WHOLE publishing company, right here in Keepers. We've regularly alerted you to new books rolling off this Washington, D.C., press, and we'll continue to do so. But the Island Press catalogs are so full of good books that I thought you'd want to have a look for yourself.



Five years after its founding in 1978, Island Press reorganized as a non-profit company that sticks solely to environmental topics, producing 20 or 30 books each year. The Fall 1992 trade catalog lists 13 new titles, covering economics, garbage, sustainable living, development, extinction, etc. A backlist of 87 more books includes such classics as Herman Daly's *Steady State Economics*, and *Rush to Burn* from *Newsday*. The 1992 *Environmental Sourcebook* lists other publishers' environmental books, too — 235 titles in all. Both catalogs are free, if you specify GARBAGE Magazine; state your preference. Island Press, P.O. Box 7, Dept. GM, Covelo, CA 95428; (800) 828-1302.

The Environmental Gardener

EDITED BY JANET MARINELLI. 96 PAGES. BROOKLYN BOTANIC GARDEN ORDERING DEPT., 1000 WASHINGTON AVE., BROOKLYN, NY 11225-1099. SOFTCOVER, $10.20 PPD.

HEY DREAMERS, THE GARDENer's wish book of the '90s has arrived! The chapter titles in the Brooklyn Botanic Garden's latest book are just what you're looking for — and the photos show backyard restoration at its most beautiful.

The front half of the book lays out some basics — composting, xeriscaping, and pesticides. Then come recipes for creating a meadow or hedgerow, a prairie, a desert garden, a California coastal garden, a New England rock garden, and more. Also check out the plans for building a stream into your habitat, and the Five Commandments for procuring native plants. There are many lists of sources, plus pesticide charts, Latin-name charts, and this-animal-likes-that-plant charts. All put together by GARBAGE's former managing editor, the marvelous Ms. Marinelli.

—Reviews by Hannah Holmes

What Puts the Pop! in Pop?

WHERE DOES CARBON DIOXIDE, CO_2, COME FROM? Does the CO_2 in soda beverages contribute to the greenhouse effect? What happens after the bubbles pop?

CHERYL SUE GATLING
Syracuse, N.Y.

WHAT HAPPENS TO ME IS A BURP, WHICH IS why I rarely touch the stuff. But then, I am among a truly minor minority: Every year, the average American consumes 47 gallons of pop. Each 12 oz. glass contains from two to four grams of CO_2. Even soda addicts needn't worry that their habit is speeding global warming, however. In the U.S., 1,275 million tons of CO_2 are released annually from other industrial sources and the burning of hydrocarbon fuel.

It's the animal kingdom (humans included!) that has long been the atmosphere's major source of CO_2, a gaseous compound of one carbon and two oxygen atoms. As you breathe, your body carries oxygen absorbed from air, via the bloodstream, to all the cells. On the blood's return trip from the cells, it removes waste products and carbon dioxide resulting from the cellular feeding frenzy. The CO_2 makes its way to the lungs and is exhaled. A fart — CO_2 along with a lot of hydrogen — is the result of intestinal activity.

Most of the rise in CO_2, which according to some scientists could be spurring a rise in global temperatures, is created by the combustion of hydrocarbon fuels: gasoline, diesel, jet fuel, coal, and oil. Burning one gallon of gasoline while driving or using one kilowatt of electricity from a coal-fired generating plant leaves behind two pounds of CO_2. Along with bakeries and breweries, processing and refining hydrocarbon fuels (such as petroleum and natural gas) produces tons of CO_2, much of which is captured for reuse. So don't sweat over pop — soda bottlers are but a minor consumer of this industrial gas.

All in all, each person in North America is responsible for five tons of CO_2 annually. To cut CO_2 output, put your energy into using less energy: lower your at-home electricity use; walk or bike when you don't have to drive and favor mass transit over cars; buy recycled products and recycle to the max, since recycling saves from 50 percent (paper) to 95 percent (aluminum) of energy compared to manufacturing products from raw materials.

Wet-Handed in Michigan

What's better, environmentally, for an office-employees' rest room: an electric hand dryer; unbleached, recycled paper towels; or a cloth-towel roller?

DEBORAH G. BLOOMFIELD
Trenton, Mich.

THE JUDGING GETS COMPLICATED BECAUSE we're comparing an appliance (hot-air blower), a product (paper towels), and a product and a service (the cloth itself and

CAMPBELL LAIRD

the cleaning company that maintains the roller). Products such as paper towels are put through a cradle-to-grave evaluation called a lifecycle analysis, or LCA, to assess their environmental impact. Paper towels which are unbleached, 100 percent recycled, and have a high percentage of post-consumer waste generally get positive LCAs; with high marks for the material, and medium marks for energy use and waste reduction.

Cloth towels? According to a study done for two textile industry groups, they get high marks for waste reduction. But low marks are given by environmentalists for the ecological toll wreaked by the cotton boll (of all the farm chemicals used in this country, over 90 percent end up in the good old cotton field). Then there are laundering methods for the cloth, which could rate from high to low. It all depends on whether chlorine bleach or phosphate detergent is used, if the rinse water is recycled, and other issues. According to a study by the American Paper Institute, a trade group representing paper manufacturers, cloth towels and recycled-paper towels are tied for air- and water-pollution potential; but paper is the clear leader in lower energy and water use and, surprisingly enough, less solid waste by weight and volume.

In a perfect world, there'd be a cloth-roller unit filled with hemp cloth that's laundered environmentally and transported in electric-power vehicles. Until then, in my humble opinion, stock your rest room with unbleached, 100-percent recycled paper towels.

Moldy Humidifiers

Does my ultrasonic humidifier foster mold growth? And does its filter remove pollutants from tap water?

MRS. WALTER F. BALLINGER
St. Louis, Mo.

YOUR ULTRASONIC HUMIDIFIER, WHICH CREates a very fine mist by rapidly vibrating water, works best when the water used is first softened (the minerals removed) and filtered. The disposable filters for ultrasonic humidifiers remove only minerals from the water, mainly calcium and magnesium. If your water's really hard, those filters may not do the trick or could fill too frequently to be affordable. If minerals are not removed, the humidifier transforms water into a fine, white dust that settles all over your house. Inhaled into the juicy confines of your lungs, these mineral particles can cause a painful respiratory condition termed "humidifier lung," with damage similar to that of asbestos in sensitive persons, according to the University of California at Berkeley's *Wellness Letter.*

Along with minerals, it's best to remove trace pollutants such as radon and volatile organic compounds from water before filling the humidifier. There are three home filtering routes for tap water: distillation, reverse osmosis, or carbon. Distillation costs big bucks and uses a lot of energy; reverse osmosis is also costly and wastes a river of water. An under-the-sink carbon filter, on the other hand, is easy to install and costs under $50. (A whole house filter costs a bit more and is usually attached by a plumber to the main water line.) A good-sized, quality carbon filter removes most pollutants from tap water except metals and minerals. Units that attach to the faucet are too small to be effective.

Filtering your home's interior air slashes the amount of mold as well as indoor-air pollutants which can infiltrate the tank. Use an electrostatic filter, either as part of a freestanding unit or as a washable filter for centralized air-conditioning systems. A good one can trap over 95 percent of mold, dust, and pollen particles from indoor air. The Sears catalog (p. 791) has excellent prices on the Dust Fighter brand; call (800) 366-3000 to order. The American Lung Association, along with the U.S. Consumer Product Safety Commission, has two free booklets on mold and other indoor humidity problems, *Biological Pollutants in Your Home* and *Humidifier Safety Alert.* Send a postcard with your name and address to CPSC, Washington, D.C., 20207.

Questions?

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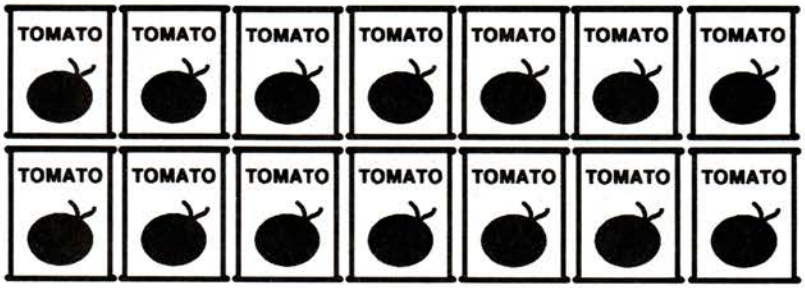

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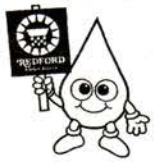

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ENVIRONMENTAL CLEAN AIR FUEL CELL

Do your part, reduce greenhouse effect emissions with the ECA Fuel Cell. The Automotive fuel hydrogen generator reduces emissions, improves gas mileage, and increases horsepower by converting water to hydrogen and oxygen gasses. Investment recovered in 1 year on many vehicles. FUELSAVERS, 3431 E. Golden Vista Lane, Phoenix, AZ 85028, (602) 996-3098.

TURN RECYCLABLES INTO TOYS, GAMES, JEWELRY & MORE

Great for schools, camps, churches, and family get togethers. Uses no special tools. For easy to follow instructions, send $5.50 to Larned-Marlow, 144 S. Monroe Ave., Columbus, OH 43205.

ARE YOU BOTHERED BY POWERLINES OR EARTHQUAKES?

Inexpensive ELF and ULF (extreme and ultra low frequency) devices are available. The ELF is designed to measure electromagnetic fields produced by 60 Hz products such as electric blankets, TVs, VTDs, etc. The ULF is designed to detect the smallest change in the earth's magnetic field. This meter has the potential of detecting those changes that occur prior to an earthquake. In some cases it can detect those changes anywhere from 3 hours to 3 days in advance. For more information, contact MEMTEC Corporation, 19B Keewaydin Drive, Salem, NH 03079, (603) 893-8080.

STOP JUNK MAIL WASTE

Save trees, protect your privacy, avoid the nuisance of junk mail with the Privacy Conservation Kit™. Unlike other methods, PCK™ eliminates your personal data at the sources. Send $19.95 to: PCK/a, Box 40160, Mesa, AZ 85274-0160.

ENVIRONMENTAL ISSUES

Carrying Capacity Network's Clearinghouse Bulletin and Focus publications are sources for information on environmental, population, growth control, and resource issues. The Bulletin tracks legislation, highlights activities of organizations, and offers opportunities for coalitions. Focus provides in-depth coverage on the issues. Call (800) 466-4866.

FINANCING FOR ENVIRONMENTAL BUSINESSES

Let the government finance you new or existing small business. Grants/loans to $500,000. Free recorded message: (707) 448-0201. (HC2)

WANTED: WRITERS

Articles are needed for vegetarian magazine. Needed are original menus, interesting ideas, and natural gardening tips. Send SASE for guidelines to: Veggie, 1320 Galaxy Way, Concord, CA 94520.

COMPACT FLUORESCENT LIGHT BULBS

Use 75% less electricity than standard incandescent bulbs, last up to 10,000 hours, and screw into regular fixtures. Free string bag with first purchase. For free brochure, contact: Green Goods Inc., Box 116, Topsham, ME 04086, (207) 721-0373.

IF YOU MUST OWN A CAR...

Buy used instead of new, but first read "How to Buy a Great Used Car" and "Avoiding Private-Party Used Car Scams." These incredibly practical guides are beautifully written and full of unique money-saving tips about finding, inspecting, and negotiating your next car. A must for every smart used car buyer. Educate yourself before spending thousands. Each guide $9.95. Both only $14.95. Absolute moneyback guarantee (you can't lose). Insider's Guide, 1016-G Livermore, Yellow Springs, OH 45387. 3% goes to Ralis-To-Trails.

CONCERNED SINGLES NEWSLETTER

Linking compatible, socially conscious singles concerned about the environment, peace, and personal growth since 1984. Featured in July/August '92 GARBAGE. Nationwide. All ages. For free sample, write to Box 555-GB, Stockbridge, MA 01262.

SAVE MONEY & LANDFILL SPACE

Research report available on Alternative Daily Cover Materials for sanitary landfills. Report reviews 7 commercially manufactured covers, 20 landfills, 70 references. For free abstract and order form send Self-addressed stamped envelope to Doug Tucker, 497 Doulgas Drive, Dept. 2, Lake Forest, IL 60045.

ENVIRONMENTAL ENTREPRENEURS

Government grants for you business venture. 10 listings; short, but oh so sweet. Send $5.00 and SASE to PO Box 1202, Mt. Pleasant, MI 48854.

THERE'S HOPE FOR SOAP — BAR SOAP SAVER SYSTEM

Recycle bar soap scraps in your microwave. Environmentally safe. Complete kit $9.95 plus $3.50 shipping and handling. Send check or money order to DeKalb Environmental Products, Box 968, DeKalb, IL 60115.

CLASSIFIEDS

Rates: $125 for the first 40 words, $2 each additional word. Submissions must be in writing and prepaid. No commissions or discounts on classified advertising. Send to: Garbage, Attn: Classifieds, 2 Main Street, Gloucester, MA 01930.

ADVERTISERS' INDEX

Paper *and* Plastic? No Thanks!

HAVE YOU SEEN IT? SHOPPERS LEAVING THE GROCERY STORE carrying a paper bag inside a plastic bag? Keep your eyes peeled — it's sweeping the nation. We like the size and rigidity of paper. Yet we crave the handles of plastic. So we'll take both! ¶ It's human nature that's in the dumpster, of course: a case of good intentions backfiring. You can't really blame the grocer, who switched to plastic to save cost and weight and transportation volume, then had to go back to offering paper bags due to public outcry over plastic's bad-guy reputation.

And it turns out you can't really blame the consumer, either. The standard grocery bag of 20 years ago was made from 70-pound paper (meaning 3,000 sq. ft. of kraft paper weighed 70 pounds). Now, 57- and 60-lb. bags are more common. How low will it go? Stone Container, the nation's largest maker of kraft paper, notes a "disturbing" rash of orders for the 50-lb. bag, which is, in the words of a spokesman, "a lousy sack for carrying groceries."

It's partly the addition of recycled fiber to bags that has flimsyfied them. But that's a minor irony compared with the baggers' approach to wimpy bags. While grocers try to save money on bags, and while enviro-aware shoppers clamor for less packaging waste, here's what the overwrought bagger is doing:

(a) filling paper bags only one-third to one-half full;

(b) doubling the paper bags, and filling them not quite two-thirds full;

(c) putting the paper bag inside a plastic sack.

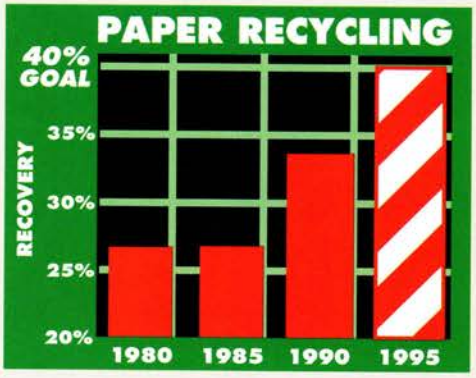
Sometimes I object, and ask for one *full* paper bag, whereupon I get a patronizing smile and the admonition, "Well, you better lift it from the bottom."

Bingo! Lift your paper bags from the bottom! And when hit with the paper *and* plastic offer, resist the urge.

P.S. My rebuttal-in-advance for shrill letters about cloth bags: Let ye who has never forgotten the string bag, throw the first ripe pear.

LILLA ROGERS

Paper's 40% goal: Together we'll make it!



Two years ago, the U.S. paper industry set an ambitious recycling goal. By the end of 1995, with the help of millions of Americans, we wanted to recover 40% of all the paper used.

It was the first goal of its kind—ever. And when it's reached, U.S. paper recovery will exceed the world average.

But to keep the progress going, everyone must work together. People must continue to sort recyclable paper, industry must invest in new facilities, and government must pursue integrated solid waste policies.

For our part, America's paper companies are investing over $3 billion in new recycling facilities. Already, nearly 100 new projects are up and running, under construction, or publicly announced. And there's more to come.

The bottom line? Paper recovery last year topped 31 million tons, and we're well on our way toward the 1995 target.

The U.S. paper industry's 40% recycling goal: Working together, we'll make it.

To learn more about paper recycling, call the American Paper Institute's Paper Information Center, 1-800-878-8878.

PAPER
The Natural Leader In Solid Waste Solutions

meth•ane div•ers, *noun* — Intrepid souls whose occupation — plunging deep into garbage to patch leaky landfills — is sure to be a conversation stopper.

Credit Wayne Brusate with coining the term. Wayne's the owner of Commercial Diving & Marine Services, an outfit in Port Huron, Michigan, specializing in underwater repair work. Six years ago, when a western Michigan landfill's leachate-collection pipes backed up, its operator signalled an SOS. (Leachate is the toxic soup that percolates through a landfill.) Mr. Brusate and a band of willing, if novice, dump divers answered the call. "Underwater diving doesn't really prepare you for the insides of an active landfill," he deadpans. "After that first dive, some of our guys wouldn't go back."

Mr. Brusate's crew of four men and two women are probably the only divers in the country working in landfills. ("Methane divers" refers to the gas produced when trash decays.)

A typical job: Fix the network of plastic pipes, flattened by tons of trash, which collect leachate.

The challenge: Wearing breathing apparatus and a butyl-rubber protective suit, squeeze into a shaft just 48 inches in diameter. Plunge (via hydraulic crane) 120 feet into the landfill's dark innards. Clear debris and repair damaged pipes without: setting a spark that might "light off the shaft" (methane is highly explosive); gagging on toxic concentrations of hydrogen sulfide; withering in the "hot zone," where temperatures soar above 100 degrees F.

The work isn't for the claustrophobic ... or the squeamish. Says Wayne Brusate, "Pretty slimy down there."